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Government and Innovation: Experimenting With Change

The Final Report of the Experimental Technology Incentives Program

Issued December 1982

Prepared for



Experimental Technology Incentives Program
National Bureau of Standards
Washington, DC 20234

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Richard Hebert,
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Washington, D.C.

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Preface

Since the business of the Experimental Technology Incentives Program (ETIP) was change, it is difficult to capture in words the dynamics of the program's process. Not even scholars can agree on what constitutes the change process or, even more importantly, how best to affect it. The ETIP program and its methodology of change is perhaps best seen as an art form, and it is for that reason the program turned in its last days to professional reporters and writers to record its story. The report contained in these pages is not an evaluation of ETIP in any definition of that word. Instead, ETIP asked Ralph Hoar and Richard Hebert to summarize from the over 100 published ETIP project reports, its many evaluations over the years, and extensive interviews or discussions with actual participants and agency partners. The report is the product of that distillation and fairly represents the history of ETIP, its major accomplishments, and its lessons for the future. In the end, ETIP hopes its actions speak at least as loud as its words and that the art form of its methods will continue to be used and refined.

ACKNOWLEDGEMENTS

Much like the work of ETIP itself, the preparation of this report was a partnership. The authors would especially like to thank Dan Fulmer for his encouragement and gentle guidance and Stephen Garrity for sifting through mountains of wheat and chaff to provide numerous documents that served as grist for this report.

The authors are also grateful for the information and insights provided by ETIP's first director Jordan Lewis and its final director Robert Parsons. Others who provided valuable guidance and consultation include Richard Penn, Gregory Tassey, Charles Hulick, Sumner Clarren, Theodore Schlie and Leonard Sawicki.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ii

EXECUTIVE SUMMARY vii

I INTRODUCTION I-1

II HISTORY AND STRATEGY II-1

A. Background II-1

B. Experimentation Strategy II-2

C Program Areas and Projects II-6

D Program Closure II-9

III ACHIEVEMENTS -- ETIP AS CHANGE AGENT III-1

A. Regulation III-2

1. FRA/ICC -- Fresh Produce Rail Transport Deregulation (Project No. 31). III-3

2. FDA -- Post-Marketing Surveillance of Drugs (Project No. 88) III-6

3. FCC -- Public Record Message Service Deregulation (Project Nos. 140 and 161) III-11

4. Marketplace and Government Results III-13

B. Procurement. III-15

1. Life Cycle Costing (Project Nos. 36 and 63). III-18

2. Value Incentive Clause (Project No. 64). III-19

3. Performance Specifications III-23

4. Veterans Administration (Project No. 80) III-27

5. Mission-Agency Strategy III-30

6. Marketplace and Government Results III-31

C. Economic Assistance III-32

1. Regulatory Impacts on Small Businesses (Project No. 28) III-34

2. Venture Capital and SEC (Project Nos. 9 and 148) . . III-36

3. Connecticut Product Development Corporation (Project Nos. 32, 78, and 136) III-40

4. Marketplace and Government Results III-42

D. Research and Development III-42

1. Integrated Utility Systems (Project No. 67) III-43

2. Flame-Retardants for Polyester/Cotton Blends (Project Nos. 7, 97, 125, 126, and 134) III-46

3. Marketplace and Government Results III-49

E. Conclusions III-50

1. Marketplace Perspective III-50

2. Government Agency Perspective III-51

IV ACHIEVEMENTS -- ETIP AS STUDENT OF CHANGE IV-1

A. Generalizable Lessons IV-1

1. Long-Term Commitment to Experimentation IV-2

2. Stakeholder Collaboration IV-2

3. Interviewing for Expectations IV-4

4. Protection of Proprietary Rights IV-4

5. Top-Level Commitment IV-5

6. Recognition of Agency Needs IV-5

7. Real-Time Monitoring for Effects IV-7

B. Program Area Lessons IV-7

1. Regulation IV-7

-- Market Mechanisms vs. Command/Control IV-8

-- Regulatory Doubt Can Impede Technological Advance IV-8

-- Technology Drives the Regulatory Game IV-9

2. Procurement IV-10

-- Product and Industry Devolopment Stage IV-10

-- Government as Major Purchaser and End User . . . IV-11

-- Government as Middleman or Broker IV-12

-- Sensitivity to Commercial Market Strategies and Perceptions IV-12

-- Procurement Used in Tandem with Other Policy Tools IV-14

-- User Roles in Development and Use of LCC Models IV-14

3. Economic Assistance IV-15

-- Industry Strategies and Government Policies . . . IV-16

-- Impact of Subsidies on Technology IV-18

-- Policy Options for Commodity Supplies IV-21

-- Small Businesses' Special Problems IV-22

4. Research and Development IV-23

-- Technology Push vs. Market Pull IV-25

-- Limited Value of Demonstrations IV-28

-- Alternative R&D Strategies IV-30

-- Consortium Viability IV-31

-- Political Sensitivity IV-34

V CONCLUSIONS V-1

A. Weaknesses V-1

1. No Overall Strategy V-2

2. Organizational Tug-of-War V-2

3. The Pressure of Time V-3

4. Ill-Prepared Hypotheses V-3

5. Changes in Context V-4

6. The Uncertainties of Behavioral Sciences V-4

B. Strengths. V-5

1. Agency Responses V-5

-- Food and Drug Administration. V-5

-- Federal Communications Commission V-6

-- Federal Supply Service. V-7

-- Securities and Exchange Commission V-7

-- Office of Technology Assessment V-8

2. The ETIP Strategy. V-8

-- Partnership V-9

-- Choice of Partners. V-9

-- Staff-to-Staff Collaboration. V-9

-- Seed Money. V-9

-- Non-Emergency Role. V-10

-- Transferral of Skills and Ownership V-10

-- Adaptability. V-10

-- Modesty V-11

-- Development of Commonality. V-11

-- Synergic Strategies V-11

C. Conclusion V-12

APPENDIX. A-1

EXECUTIVE SUMMARY

A. HISTORY AND STRATEGY

From 1972 to 1982 the Experimental Technology Incentives Program (ETIP) of the National Bureau of Standards carried out more than 200 experiments and studies to better understand how government policies impact private-sector inventiveness and to improve those impacts.

ETIP adopted a strategy of experimentation with incremental changes in administrative policies and procedures in Federal agencies. Major components of this strategy included:

- Selection of agencies already inclined toward change where it was hypothesized the change, if properly planned and implemented, would result in an improved environment for private-sector innovation;
- Collaborative problem-solving by involving all stakeholders in the planning, implementing, and evaluating of the experiment;
- ETIP's role of neutral third-party facilitator;
- Continuing feedback of data on the experiment's private-sector impacts for use in evaluating results and planning successive modifications and incremental changes; and
- Emphasis on transferring ETIP's skills, perceptions, and methods to line agencies and institutionalizing those changes found beneficial.

This strategy meant that ETIP served both as a catalytic agent for change and as a student of change and its effects. ETIP applied the strategy to four areas of Federal policy and activity: regulation, procurement, economic assistance, and research and development.

Approximately $2[illegible] million was appropriated by the Congress to ETIP during its ten years. Beginning with a Domestic Policy Review of Innovation effort in

effort in 1979, ETIP activities were redirected to new initiatives and no new experiments were permitted. Phasing out of ETIP activities continued with the change of administrations in 1981 and the program was terminated at the close of 1982.

B. ACHIEVEMENTS AS CHANGE AGENT

1. Regulatory Program Area

Following are among the major marketplace and government agency changes that resulted from ETIP regulatory experiments and studies:

- o A study of economic impact data prepared by experts in the field led to deregulation of rail transport of fresh produce and of intermodal transports. This resulted in adoption of new technologies by the railroad industry.

- o Institutionalization in the Food and Drug Administration (FDA) of a systematic program of post-marketing surveillance for adverse drug reactions and other procedure modifications held promise that drug-approval time might be reduced.

- o The public message services industry was opened to competition by changes in policies and procedures of the Federal Communications Commission (FCC). An approach for developing and using data-collection techniques to monitor the telecommunications industry to inform future decision-making by FCC was institutionalized.

2. Procurement Program Area

Following are among the major marketplace and government agency changes that resulted from ETIP procurement experiments and studies:

- o Innovative techniques (Life Cycle Costing, Value Incentive Clauses, Performance Specifications) were institutionalized at the Federal Supply Service (FSS), resulting in cost-savings and some directly attributable product innovations.

- o A comprehensive Life Cycle Costing approach to analysis of options for meeting Federal space requirements was established for the Public Buildings Service (PBS).

- o A "how to do it manual," training sessions, technical assistance, and documentation of success stories were provided for those interested in using Life Cycle Costing techniques.

- o Innovative procurement strategies were adopted by mission-oriented Federal agencies with built-in incentives for fostering technological advance (e.g., Department of Defense (DOD), Department of Energy (DOE), Environmental Protection Agency (EPA)).

- o These procurement techniques were formally adopted as part of ongoing government policies by the Office of Management and Budget (OMB).

3. Economic Assistance Program Area

Following are among the major marketplace and government agency changes that resulted from ETIP studies and experimentation with economic assistance programs:

- o The Small Business Administration (SBA) increased its intervention in regulatory rule-making that affects small businesses and stepped up technical assistance to help small firms meet regulatory requirements.

- o The Securities and Exchange Commission (SEC) institutionalized a computer-based data-gathering, monitoring, and evaluating model to inform regulatory decision-making. Resulting rule and reporting-form changes substantially reduced the burdens on small technology-based firms.

- o Guidelines were developed for future efforts by quasi-public bodies to inject capital funds into product development, based on monitoring of the Connecticut Product Development Corporation (CPDC).

4. Research and Development Program Area

The following are among the major marketplace and government agency changes that resulted from ETIP studies and experimentation with Federal research and development programs:

- o Three major institutions committed themselves to construct Integrated Utility Systems (IUS) as the result of ETIP-funded feasibility studies, demonstrating the value of this strategy over traditional Federally-funded demonstration projects.

- o Guidelines were developed for using R&D consortia as a result of ETIP's organization and supervision of a consortium to develop fabric flame-retardants.

Other R&D Program Area initiatives by ETIP were studies of the impacts of traditional Federally-funded R&D and demonstration projects which generated a number of guidelines for future efforts, discussed in Chapter IV of this report. The guidelines were adopted formally by EPA, OMB, and the Energy Research and Development Administration (ERDA) as a result of ETIP's collaborative efforts with those agencies.

C. LESSONS LEARNED

At the outset almost nothing was known about how Federal actions impacted private-sector innovation. In its ten years, ETIP made important advances in filling that knowledge gap. The major lessons learned:

- The interplay of government and industry is more complex and involves more factors than the two-sided equation traditionally assumed. To be effective government must tailor policies and procedures to the broad spectrum of marketplace forces.

- Considerable time, money, and care need to be invested in experimentation with incremental government change if government activities are to be modified in a credible and effective way to influence technological innovation.

- Any strategy aimed at modifying government behavior so as to foster private-sector innovation must necessarily involve stakeholders from all sectors and should rely on credibility built by use of outside experts in the substantive fields.

- Interviews to determine stakeholder expectations from the experimental changes should be done at the outset to clarify objectives and assure that those objectives are realizable.

- Protection of developers' proprietary rights in new products and product innovations appears essential if government intervention in the private sector is to have a favorable and significant impact on technological innovation.

- Top-level agency commitment to experimentation is necessary to keep political and other pressures off agency experimenters and to avoid disruptions in what is necessarily a long-term effort.

- Line-agency staff and decision-makers have differing needs from any given experiment with change. All these needs should be addressed in the design of the experiment.

- Line agencies need analyses of economic-impact data in order to base decision-making on real-world events. Conventional economic tools cannot be applied directly to policy analysis.

- Retrospective analyses and evaluations of government activities can never substitute for the benefits derived from real-time monitoring and feedback of impact-data to decision-makers.

In addition, ETIP generated a number of program area-specific lessons, discussed in Chapter IV. Following is a sampling of the most significant:

- Government's regulatory actions significantly affect private industry's willingness to venture into innovative technologies. Chief among these impacts is doubt about regulatory intentions.

- A market mechanism approach to regulation is more desirable and efficacious than the traditional command/control strategy.

- The most important factor influencing whether procurement and other government incentive strategies will affect industrial innovativeness is the stage of maturity of the product and its industry. The impact is likely to be greatest at the earliest stages of product/industry development.

- Federal procurement's influence on innovation can be expected to be most effective when government is itself the major purchaser and end user of the innovation. Cooperative agreements are the preferred strategy of procurement when government is not the major purchaser or end user.

- Procurement strategies aimed at stimulating industrial innovation can be effective when they are congruent with commercial market strategies.

- Government assistance can have a direct effect on firms pursuing incremental innovation strategies but only indirect effects on those pursuing major innovation strategies because of the interplay of key variables in such ventures.

- Subsidies have their greatest impact on technological change in those cases where they are a relatively important element in a set of coordinated government programs specifically aimed at technological innovation and diffusion.

- Policy-makers in subsidy-granting agencies apparently pay little attention to the possible impacts of subsidies on technology change

and have missed opportunities to use technological change to help achieve the goals of the subsidy programs.

- o Stockpiling is not generally an appropriate government strategy against critical material shortfalls. R&D aimed at producing substitution technologies in line with projected mineral costs might be appropriate.

- o Small businesses face special problems in their attempts to meet Federal regulatory requirements.

- o R&D and demonstration projects have had limited value in fostering diffusion of new techologies because each is but a small part of the total cost of bringing technological innovation into the marketplace. R&D funding policies should be formulated in the larger context of the complex process of innovation.

- o Technology is more likely to be "pulled" into the marketplace by favorable conditions among potential users than it is to be "pushed" by government subsidy or R&D funding.

- o Before embarking on subsidization, R&D funding, or a program of demonstration grants, government should explore alternative strategies, including feasibility studies and consortium techniques.

D. CONCLUSIONS

Throughout its history ETIP learned about government-to-government change inducements from both its successes and failures. Its weaknesses derived in large measure from the "real-world" environment in which its experimentations took place -- an environment which at best provided only moving targets and required ETIP to engage in the less-than-exact behavioral sciences.

Line-agency staff which worked most closely with ETIP lauded its endeavors, its skills, and its seed money as essential to the successful changes implemented. The strengths derived from ETIP's strategy included:

- o The development of partnership relationships with agency "targets of opportunity," which contributed to successes and generated ETIP credibility among other agencies;

- o Collaborative techniques by which ETIP avoided developing "authority" over its partner agencies;

- o Provision of seed money to budget-constricted line agencies which otherwise could not have funded the experiments;

- o Protection from being drawn into the role of "fire-fighter," which helped protect ETIP's commitment to long-term experimentation with incremental change;

- o Emphasis on the transferability of ETIP's skills, perceptions, and expertise, which resulted in a disproportionate impact by being able to reproduce itself within its partner agencies;

- o The ability to adapt its approach to the uniqueness of each situation;

- o The ability to develop common goals, common language, common understandings, and common strategies with agency partners; and

- o Avoidance of adversarial strategies.

ETIP successfully showed that monitoring the private-sector impacts of government activities and modifying those activities based on analyses of the results of that monitoring can and will foster technological advance in the private sector. Further, it showed that such monitoring and analyses for appropriateness can be institutionalized in government agencies to support incremental change in policies and procedures. Finally, ETIP developed considerable knowledge about government-industry interactions that can serve future decision-making, should the need for experimentation with government activities to encourage technological innovation be rediscovered.

I. INTRODUCTION

The President's 1972 Message to the Congress on Science and Technology[1] stated:

> The ability of the American people to harness the discoveries of science in the service of man...has undergirded both our domestic prosperity and our international strength... (p. 1).
>
> ...(T)he mere act of scientific discovery alone is not enough. Even the most important breakthrough will have little impact on our lives unless it is put to use -- and putting an idea to use is a far more complex process than has often been appreciated... (p. 2).
>
> ...(W)e must see that the environment for technological innovation is a favorable one. In some cases, excessive regulation, inadequate incentives, and other barriers to innovation have worked to discourage and even to impede the entrepreneurial spirit. We need to do a better job of determining the extent to which such conditions exist, their underlying causes, and the best ways of dealing with them... (p. 2).
>
> There are many ways in which the Federal government influences the level and the quality of private research and development. Its direct supportive efforts are important, but other policies -- such as tax, patent, procurement, regulation, and antitrust policies -- also can have a significant effect on the climate for innovation... (p. 6).
>
> ...(W)e need to be better informed about the full consequences of all such policies for scientific and technological progress (p. 7).

The Experimental Technology Incentives Program (ETIP) was initiated in FY 1973 in the National Bureau of Standards as a pioneering effort to understand and improve the three-way relationship of government, free enterprise, and technological advance. Its express purpose, as stated by the President, was "to determine effective ways of stimulating non-Federal investment in research and development and of improving the application of research and development results" (p. 8). The program was terminated almost a decade later, at the end of 1982.

1. "Message from the President of the United States Concerning Science and Technology," 1973 (House Document No. 92-193).

Early in its evolution ETIP focused its efforts on government, primarily Federal agencies. Their accessibility and, in many cases, willingness to change made them ideal environments in which to experiment with techniques to foster private-sector technological innovation. During its ten-year lifespan more than 200 projects explored how government policies and procedures affect the pace, direction, and deployment of technological innovation in the private economy. The research, in turn, was to suggest changes in government that would remove obstacles to innovation and replace them, where possible, with incentives.

ETIP was the subject of repeated evaluations. Gerald M. Britan, Assistant Professor of Anthropology and Urban Affairs at Northwestern University, conducted one of these for the National Academy of Sciences between 1975 and 1977. He wrote:[1]

> ...(By 1975) it was already clear that ETIP was itself a far more significant experiment than any of its policy initiatives. The program represented a radical innovation in the process of policy change.

This, the final ETIP report, is intended to be an overall record of the ETIP experience: the course of its development, the nature of its experiments in government change, its accomplishments in altering both government perceptions and practices and their resultant impacts on private-sector innovation, and the lessons ETIP learned about the interplay between government policies and private initiatives. As such it serves as a road map for those who wish to study in detail the history of ETIP's specific activities. The primary audience for the report consists of students and practitioners of public administration

1. "Bureaucracy and Innovation, An Ethnography of Policy Change," Gerald M. Britan, Sage Library of Social Research, Vol. 115, Sage Publications, Inc., 1981, p. 9.

and policy-making who are confronted with questions of how better to organize government activities and improve their impact on the industrial economy.

The report is not intended to repeat the detailed records and data on each of ETIP's studies, experiments, and other activities. Those records are available from other sources. Interested parties can locate them using footnotes in this report and the Appendix.

The report has been prepared by persons not directly involved in ETIP in an attempt to avoid bias. It does not contain new information or analyses. Rather it is a distillation of information gathered from interviews with ETIP personnel and from internal ETIP documents, project reports by ETIP and its several outside contractors, and evaluations of its activities by numerous agencies, including the Department of Commerce, other Federal agencies, review panels established under the auspices of the National Research Council, and outside contractors.

Chapter III highlights a variety of ETIP projects, their task objectives and their results. Those projects are included which best illustrate the ETIP method and its application and achievements. Chapter IV discusses those same projects and others in terms of the "lessons" ETIP learned about how government can influence private-sector innovation.

Task objectives for each ETIP project frequently were modified during the life of the particular project as the result of mid-course findings. Thus, simple comparison of results with the initially stated objectives of each project is not always useful or instructive. However, ETIP did establish these three overall objectives for its program:

- To develop generalizable information on how government processes impact private-sector innovation;

- To test hypotheses on how government processes can benefit private-sector innovation; and
- To construct an experimental methodology for agencies to use in reforming their processes of implementing policy.

Because of the diversity of points of view among those who participated in ETIP activities and the difficulties posed in measuring results against stated objectives, this report does not attempt to state "official" conclusions. Rather, Chapter V presents the impressions of a variety of persons who were involved with ETIP either as participants or as close observers, evaluators, and/or users of its experiments and their results.

II. HISTORY AND STRATEGY

A. BACKGROUND

In 1971 several studies were commissioned under the New Technology Opportunities Program of the Domestic Council to determine how science and technology initiatives could be used by the Federal government to spur the nation's economy.

These studies resulted in many proposals for Federal research and development (R&D) projects, but also showed that surprisingly little was known about how such federally-initiated R&D actually affects technological innovation in the marketplace. It was found, for example, that such factors as customs, regulations, Federal procurement policies, tax laws, subsidies, and general financial conditions also affect the entrance of R&D-spawned technology into the private sector, but the lack of information about the interplay of R&D and these other factors made it difficult to select projects and programs which would best affect the pace and direction of private-sector innovation.

To supply the needed information, the President in 1972 directed the National Bureau of Standards to establish the Experimental Technology Incentives

1. This section is drawn from several documents devoted to ETIP history: "Experimental Technology Incentives Program, History Development," 1976, a briefing paper written by ETIP for the Department of Commerce; "Potential Problems That Should Be Considered in Evaluating the Experimental Technology Incentives Program," 1977, Government Accounting Office overview of the program; "Public Policy and Innovation: An Overview of the Experimental TechnologyIncentives Program," 1977, Gerald M. Britan, an evaluation of ETIP for the National Academy of Sciences; "The Experimental Technology Incentives Program: Progress and Impediments, An Information Base for Program Evaluation," 1977, Thomas V. Kelly, Department of Commerce evaluation; and "The Experimental Technology Incentives Program, Brief History and Major Accomplishments," 1981, a briefing paper written by ETIP for the Department of Commerce.

Program (ETIP) "to determine effective ways of stimulating non-Federal investment in research and development and of improving the application of research and development results."[1] The National Science Foundation was directed to establish a supporting program to generate ideas and opportunities for ETIP experiments.

B. EXPERIMENTATION STRATEGY

The strategy adopted by ETIP was to develop experiments jointly with selected government agencies in which, it was hypothesized, agency policies and tools might be modified to spur the rate at which technological innovations were developed and introduced into the private sector. Such experimentation itself was a novelty in government, where traditional strategies had been R&D demonstration projects and "blind leap" policy modifications which may or may not have proven useful or beneficial. As pointed out in an article early in ETIP's history, "In an experimental situation...a relatively high rate of failure can be condoned and viewed as a learning experience. No is a valid answer."[2]

The strategy involved actual policy-makers in the ETIP process, offered ETIP opportunities to study a broad range of policies and tools believed to affect innovation, and provided a manageable way of obtaining information previously lacking.

The approach came to be identified within ETIP as "administrative experimentation" -- introduction of change in a systematic way that advanced only a few

1. Op. Cit., p. I-1, p.8.
2. "ETIP: A Remarkably Better Way," by John F. Judge, Editor, Government Executive, July 1975.

steps at first, collection of data about initial effects of the changes, and information feedback for use in planning incremental steps until the new policy or process was institutionalized or rejected.

By design, administrative experiments had twin objectives. One, that of the participating agency partner, was to find ways to improve agency performance and effectiveness. The other, that of ETIP, the researcher, was to identify how changes in agency activities would affect innovation. Thus, for an experiment to take place the critical factor needed was a mutual interest in change. Agencies offered the policy-making environment and an interest in changing their operations for their own reasons, which sometimes included an interest in technological innovation. ETIP offered resources for designing and evaluating the experimental changes. Each partner benefited, although in different ways. In practice, ETIP became both a student/researcher of the change process and a catalyst/facilitator of that change. Program results became closely identified with the goals of specific agencies with which ETIP worked, and success of the experiments was defined as the development and use of innovative and innovation-stimulating processes by those partner agencies.

Administrative experimentation, as developed, funded, and implemented by ETIP, had two major advantages. First, it allowed ETIP and its stakeholder-partners from both government and industry to gain actual experience with policy change. Second, it afforded both line-agency decision-makers (who would be expected to approve the change found valid in the experiment) and line-agency staff (who would be expected to implement it) an opportunity for firsthand experience with the change, which proved invaluable in facilitating the transition from experiment to formal implementation.

The key components of the strategy included:

- o Collaborative problem-solving. ETIP actively sought throughout an experiment, from identification of initial hypotheses to be tested through the design, implementation, mid-course correction, and final evaluation of each project, the participation of all involved stakeholders, including government line-agency personnel, relevant industry and user groups, and academic and legislative interests. It found this a particularly safe way to bring public and private sector groups together as partners rather than in their more traditional roles as adversaries.

- o Third-party facilitation. ETIP adopted in each experiment a neutral third-party role to effect this collaboration. As facilitator it provided seed money that frequently opened doors to agencies and fostered their willingness to experiment with change they could not otherwise have done because of funding limitations and the consequent need to divert funds from ongoing, mission-oriented activities. Further, both government mission-oriented agencies and the private-sector groups with which they dealt perceived ETIP as having "no ax to grind."

- o Focus on expectations. At the outset of each experiment ETIP interviewed all stakeholders to learn the expectations they brought to the experiment. Arraying these expectations helped clarify the objectives being sought and determined whether those objectives were in fact realizable.

- o Feedback of field data and evaluability. Ongoing collection of field data during experiments was essential to the ETIP process. It afforded continuing involvement by all stakeholders, provided experimenters with information needed to make mid-course corrections in the experiment itself, and allowed ongoing evaluation of experiment results. Furthermore, it set in motion the apparatus and procedures for continued gathering of field data needed by line-agency decision-makers for further incremental changes in policies and procedures and for instituting new activities or abandoning old ones found deleterious.

- o Emphasis on transferability. The end result sought by ETIP was institutionalization of those concepts and policies proved valid by an experiment and, even more important, institutionalization within line agencies of the ETIP process itself -- the willingness to experiment with incremental change in policy and procedures in a way that would result in valid, credible answers.

ETIP intervention in government procedures itself represented an innovative blend of "science" and "politics." The administrative experiment was neither

"pure science" subjected to the rigors of controlled laboratory or field experimentation methodology, nor "pure politics" freed of all scientific constraints for data analyses and evaluation of results.

Evaluability became a keystone of the ETIP method as a result of mid-course corrections made in 1977. ETIP's evaluability assessment contractor was an essential participant and a stakeholder in each of ETIP's experiments. Evaluation of results was designed into each project at the outset, and monitoring for evaluability was made an integral and ongoing part of each project.

Ongoing evaluability engendered both a flexibility in project design that permitted "fine tuning" during the course of the project and the "scientific rigor" of assuring that project results could be subjected to analysis which would yield valid responses to hypotheses being tested. Additionally, the strategy helped ETIP earn credibility among line agencies and other stakeholders as a neutral third-party "facilitator" interested in those stakeholders' objectives (e.g., improved line-agency operations, improved industry profitability) as well as in ETIP's own objective of deriving valid information about government-industry interactions.

The evaluability contractor, the Performance Development Institute (PDI) of Washington, D.C., noted both special assets and limitations in the overall administrative experimentation strategy:[1]

> The interactive process of administrative experimentation provides a useful basis for making modifications as events unfold. However, the nature of this approach makes it unlikely that broad generalizations will be developed as quickly. Special synthesis work is necessary....

1. "Finding and Encouraging Innovation: Approaches to Investigating the Relationships Between Industrial Innovation and Regulation," Warren Frederick, Joe Nay, Performance Development Institute, Washington, D.C., June 1980, pp. 52-53.

> Only to the extent that there is a very specific administrative purpose involved, will this approach suggest "what should be"....

C. PROGRAM AREAS AND PROJECTS

Although the President's 1972 message focused exclusively on Federal R&D, ETIP recognized early that a much wider range of government activities would have to be considered. In fact, by its termination there was a growing consensus within ETIP that innovation was influenced by a broad spectrum of government agencies and programs that at first glance have little or no bearing on new-product research and development.

ETIP examined a wide range of factors and governmental activities believed to affect the willingness of the marketplace to develop and adopt new technology. Four program areas were targeted for experimentation in 1974: procurement policy, regulatory policy, private-sector research and development policy, and small-business policy. Advanced planning and research was subsequently added to ETIP activities to provide overall project development, planning, and evaluation. In 1975, the small business program area was expanded into a new economic assistance program area and an experimental methods area was created to design and evaluate projects.

A partial list of ETIP activities (some of which are discussed more fully in Chapters III and IV) illustrates the range of agencies with which ETIP developed a working partnership and the breadth of projects undertaken with these partner agencies. ETIP worked with:

Government Regulation

- The Federal Communications Commission (FCC) in deregulating and fostering competition in the public record message industry (Project Nos. 140 and 161);

- The Federal Railroad Administration (FRA) and the Interstate Commerce Commission (ICC) in deregulating rail shipments of produce (Project No. 31);

- The Environmental Protection Agency (EPA) in reforming reporting requirements for pesticide firms to eliminate unnecessary burdens on industry (Project No. 48);

- State public utility commissions in developing ways to reduce the time required to decide rate cases and in introducing analyses for rate-case decision-making, thus facilitating introduction of cost-cutting technologies (Project No. 76);

- The Food and Drug Administration (FDA) in improving the drug-approval process by developing ways to anticipate regulatory burdens on bringing new drugs to market and by developing cost-effective post-marketing surveillance programs (Project No. 88);

Procurement

- The Federal Supply Service (FSS) in a series of experiments applying Life Cycle Costing, performance specifications, and Value Incentive Clauses to government procurement (Project Nos. 2, 36, 63, and 64);

- The General Services Administration (GSA) in developing methods for using government procurement (a) as an early market for innovations, (b) to develop prototypes, and (c) in market-testing of new innovations;

- EPA, the Departments of Transportation (DOT), Defense (DOD), and Energy (DOE), and the Office of Management and Budget (OMB) to institutionalize innovative procurement strategies designed to foster technological advance;

Economic Assistance

- The Securities and Exchange Commission (SEC) in developing and institutionalizing a computerized model for evaluating the private-sector economic impacts of changes in rules and regulations (Project No. 148);

- o The Small Business Administration (SBA) in redirecting its activities to help small technology-based firms meet regulatory requirements (Project No. 28);

- o Outside consultants in evaluating a range of Federal policy tools (e.g., subsidies, R&D funding, tax and trade laws, commodity stockpiling) which would help the private sector in its innovative endeavors while helping the Federal government achieve national policy goals (Project Nos. 15, 17, 93, 130A, 132, and 167);

- o The Connecticut Produce Development Corporation (CPDC) in evaluating its effectiveness in fostering development of new products by small high-technology firms and developing guidelines for future similar efforts (Project Nos. 32 and 78);

Research and Development

- o The Department of Health, Education and Welfare (HEW) in demonstrating the feasibility of commercial application of Integrated Utility Systems (Project No. 67);

- o A Clemson University-led consortium for developing flame-retardants for apparel fabrics in a demonstration of the merits of the consortium approach to R&D (Project Nos. 7, 97, 125, 126, and 134); and

- o EPA, OMB, and the Energy Research and Development Administration (ERDA) in incorporating within those agencies' procedures and policies a set of guidelines for structuring and/or approving demonstration project budgets.

ETIP received nine appropriations from the Congress totaling approximately $25 million. Distribution of these funds among ETIP activities was as follows:

- o Staff and administration -- $6.5 million;

- o Procurement projects -- $6.5 million;

- o Regulatory projects -- $5 million; and

- o Economic assistance, civilian R&D, and small business projects -- $5.5 million.

The remaining $1.5 million was used in support of a Domestic Policy Review of Innovation (DPR) and related tasks within the Department of Commerce. The DPR was established in 1979 to determine what had been learned about stimulating innovation in the private sector and what new initiatives should be undertaken.

It was similar in nature and scope to the previous effort which had resulted in the establishment of ETIP.

D. PROGRAM CLOSURE

During the DPR the reorganized Office of the Assistant Secretary of Commerce for Productivity, Innovation, and Technology concluded that ETIP had demonstrated a number of ways in which government could stimulate technology and that these mechanisms should be passed to the appropriate agencies. In effect, this was a determination that ETIP was no longer "experimental" and that its work was completed. The Assistant Secretary redirected the program towards support of new initiatives recommended by the DPR: studies of patent policy, a program for utilizing technology developed in Federal laboratories, studies of the feasibility of developing reference services to provide industry access to Federal technological information, and development of models to assess industrial sectors where government intervention might be warranted to stimulate technology. Remaining ETIP projects were to continue to completion, but no new experiments were to be initiated.

ETIP was renamed the Office of Strategy and Evaluation and was to be moved into the office of the Assistant Secretary as support staff in 1980. The change of administrations in 1981 interrupted this reorganization but continued the phasing-out of ETIP as ordered by the departing Assistant Secretary. Experiments with economic assistance and procurement were completed in 1981, and those with regulatory policies were terminated in 1982. Technology studies begun as DPR initiatives were completed in 1981. With no new funding from the Congress,

the Experimental Technology Incentives Program ended in late 1982. Its final activities were to transfer to interested agencies the knowledge it had gained and to leave a record of its activities and accomplishments for those interested in facilitating innovation in government and industry.

This final report, summarizing as it does the ETIP experience, its successes and failures, and the lessons that were generated by both, can be considered a final installment of ETIP information considered useful to agencies interested in profiting from ETIP by institutionalizing its results and methods.

III. ACHIEVEMENTS -- ETIP AS CHANGE AGENT

The achievements of ETIP can be assessed from each of three vantage points.

1. The Marketplace: Did ETIP's experiments succeed in stimulating private technological initiatives or, at the least, in removing government obstacles to them so as to permit those initiatives to take place and new products to be introduced into the marketplace more efficiently?

2. Government Line Agencies: Did ETIP succeed in redirecting or otherwise altering government agency policies or procedures in the belief that such changes would result in an improved climate for technological advance in the private sector, even if new products were not immediately developed and/or introduced into the market- place?

3. ETIP: To what extent did the program achieve its overall objective, that of developing an understanding of:

 - The complex process by which technology is introduced into the marketplace;
 - The government impediments to such introduction and how their effects might be alleviated;
 - How government policies and procedures might be used to stimulate innovation; and
 - The most effective ways of bringing about government innovations that can in turn stimulate the desired technological advance.

This chapter addresses the first two of these measurements. That is, it discusses ETIP's achievements as change agent within government and the effects of those government changes on technological innovation in the private sector of the economy. Although considerations from each of the three vantage points necessarily overlap those from the other two, Chapter IV will attempt to isolate and discuss ETIP's achievements as a student of the innovation process: the lessons it learned about the complex interweave of government and private sector actions that results in either successful and efficacious diffusion of new processes and technology or the hindrance of such diffusion.

As previously described, ETIP experiments and studies were conducted in each of four areas of government activity: regulation, procurement, economic assistance, and research and development. Accordingly, this chapter organizes ETIP activities under these same headings.

A. REGULATION

The Federal government's regulatory power is exercised for a variety of reasons, among them protection of public health and safety, protection of the environment, and avoidance of undesirable commercial practices. Inasmuch as regulations normally are written to achieve a public protection objective, the effects of such regulations on technological advance generally have not been considered by the regulating agencies. Thus, it was hypothesized by ETIP, some regulations act as unnecessary barriers to innovation by increasing market uncertainties, by raising the costs of new product development, and by distorting investment allocations in the "free market." These, it was posited, could become increasingly deleterious unless adequate consideration was given to ensure that a favorable climate for technological advance prevailed.

The primary concern of ETIP's regulatory area activity was "to develop knowledge about changes in regulatory processes that might provide incentives or reduce barriers to technological innovation."[1]

Under this umbrella objective ETIP sought to establish the credibility of administrative experimentation as a policy improvement tool within regulatory

1. "Experimental Technological Incentives Program Regulatory Policy Area Plan," Daniel W. Fulmer, Regulatory Group Leader, Experimental Technology Incentives Program, June 28, 1977, p. 1.

agencies and to develop and refine a strategy for experiment selection and management.

ETIP's "administrative experimentation" approach to regulatory reform was based on recognition that regulatory agencies historically had been faced with only two alternatives -- the status quo or "blind leaps into an uncertain future."[1] The "administrative experiment" offered a third option: introduction of incremental change in a planned, systematic, and data-supported way. Much of the work was performed in the field and with as much teamwork as possible among parties with differing viewpoints. Additionally, using interviews to gather information encouraged development of consensus where it might not otherwise have occurred through formal inquiry or written docket procedures.

Using this approach, ETIP developed partnerships with regulatory agencies which wished to effect significant operational change and were also responsive to ETIP's experimentation goals. Conversely, ETIP was viewed as responsive to the administrative goals of the partner agencies.

The regulatory experiments that resulted involved ETIP in activities with a number of Federal agencies including, among others, those discussed in this section: the Federal Railroad Administration (FRA) and Interstate Commerce Commission (ICC), the Federal Communications Commission (FCC), and the Food and Drug Administration (FDA).

1. FRA/ICC -- Fresh Produce Rail Transport Deregulation (Project No. 31)

In the 1970s the railroad industry had become increasingly alarmed that a rapidly declining portion of perishable produce was being shipped by rail. It

1. Preface of "Toward Competitive Provision of Public Record Message Services?" by Daniel W. Fulmer, Regulatory Group Leader, Experimental Technology Incentives Program; Interim Report by The Regulatory Center at the Performance Development Institute, Washington, D.C., October 1981 (NBS-GCR-ETIP 81-97) p. iv.

was argued that ICC rate-setting placed railroads at a competitive disadvantage with the trucking industry, whose produce shipments were not subject to ICC rate-setting, and thus made rail shipment of fresh produce too unprofitable to permit investment in new technologies, some of which were already available or ready for development.

ETIP involvement began in 1974 with a study funded jointly with the Federal Railroad Administration (FRA) and conducted by Manalytics, Inc., of San Francisco, California, and Reebie Associates of Greenwich, Connecticut. The study team analyzed data on sample shipments for selected commodities from four areas to five distribution markets and conducted interviews with approximately 500 stakeholders. The study resulted in an 11-volume report[1] which concluded that rail shipment of fresh produce would disappear in the near future unless the industry invested in new intermodal equipment.

> ...(T)he trucking industry will remain the "backbone" of produce transportation. However, there is a "viable role" for rail transportation in this market, if the problems...(of) rail service, rates, profitability, and equipment are addressed. A viable role can be best achieved if railroads, shippers, and receivers make necessary service, financial, and volume commitments.
>
> ...(T)he most important single step...is exemption from Commission rate and service regulation. This is a necessary prerequisite for the negotiation of rate and service contracts "outside the normal regulatory environment, with its procedures for protest and commission review" (Vol. 2, p. 28).[2]

ETIP contractors briefed ICC policy-planning staff on the findings. As a result of that briefing and a series of exploratory meetings, ETIP and ICC entered into an interagency agreement to conduct regulatory administrative

1. "A Long Term Study of Produce Transportation," Federal Railroad Administration Report, December 1977 (FRA-OOPO-78-2).

2. "Interim Report on Potential ICC/ETIP Administrative Experiments," March 1980 (NBS-GCR-ETIP 80-85) p. II-10, 11.

experiments. Involvement by ETIP, The Urban Institute, and later the Performance Development Institute, contracted to perform project evaluation, was governed by two tenets:

- Any regulatory policy change under consideration should be of such a nature and so structured to serve as a sufficient incentive that the regulatees (railroads, shippers, and receivers) will respond positively by planning for or implementing desirable changes in operations and service and equipment innovation. That is, the policy change will not be ignored by the private sector.

- Any regulatory policy change should be capable of being measured in terms of the initial response to the policy change (Do regulatees take advantage of regulatory exemptions? Do they make plans for changing operations on the basis of changed policy?) and the eventual impact and causal linkages to changes in productivity and the introduction of technological innovations.[1]

In 1978 the Southern Pacific Railroad, using data from the Manalytics/Reebie study, petitioned the ICC for exemption from economic regulation of the transport of livestock, fish and shellfish, and unmanufactured agricultural commodities on the grounds that the trucking industry's transportation of these commodities was already exempt. Three months later ICC dismissed the petition and initiated Ex Parte 346 rule-making proceedings to consider the issues raised by Southern Pacific.

The Notice of Proposed Exemption explicitly referenced the report prepared for ETIP and "the Commission's public discussion of the proposed deregulation indicated substantial reliance upon the factual and analytical basis contained in the Manalytics study to support such a proposed policy change. The Commission's discussion also expressed interest...in treating regulatory policy changes as experiments, the consequences of which should be evaluated in order to inform decision-making on further deregulation steps."[2]

1. Ibid., p. II-13, 14.
2. Ibid., p. I-7.

The effort culminated in deregulation of rail produce shipments in March 1980. An initial evaluation was conducted by ICC at that time, and Manalytics and ETIP developed a seminar and report on innovation in rail management that immediately followed deregulation. An intermediate evaluation was subsequently funded by FRA and ETIP with the cooperation of ICC but budget cutbacks associated with the closure of ETIP terminated the project before contract services could be procured for the evaluation. ICC did, however, expand the experiment by deregulating rail shipment of other commodities and of "piggyback" shipments in general.

These deregulations stimulated new investment in improved technology, including "innovations in intermodal railcar design, many of them aimed at weight reduction and aerodynamic improvement."[1] Further, ETIP succeeded in institutionalizing within ICC the concepts that analyses of the economic impacts on new technology are proper considerations in rate-setting and other regulatory procedures, and that ongoing evaluations of the impacts of regulatory changes on technological innovation are legitimate and informative processes for regulatory agencies to institute.

2. FDA -- Post-Marketing Surveillance of Drugs (Project No. 88)[2]

In 1975 ETIP began exploring with the FDA the possibility of speeding and otherwise improving the approval process for new prescription drugs. This was to be accomplished by an administrative experiment to design, implement, and

1. "It's A Growth Market Again," Gus Welty, Railway Age, November 30, 1981.

2. This section is drawn in part from "The Experimental Technology Incentives Program: Progress and Impediments, An Information Base for Program Evaluation," Thomas V. Kelly, Office of Budget and Program Evaluation, U.S. Department of Commerce, August 1977, pp. 143-152.

evaluate the effects of several components of a comprehensive system for post-marketing surveillance of prescription drugs. It was hypothesized that new data acquisition and analysis procedures would speed the process without adversely affecting public safety, and that this speed-up and consequent reduction in the "lag" between new-drug development and commercialization would improve the climate for innovation by the pharmaceuticals industry.

Protracted negotiations preceded development of an ETIP-FDA agreement. A year after negotiations commenced ETIP and FDA approved the plan and signed an agreement transferring $1.1 million from ETIP to FDA for partial support of the project.

It took two years to develop the experiment from the start of formal conversations through issuance of a Request for Proposal (RFP) in July 1977. To some extent this was the result of a conscious ETIP strategy based on prior experience -- that a long lead time would enable its staff (a) to become thoroughly familiar with the FDA, its context, problems, and potential areas of concern; (b) to develop a base of support in and a working relationship with relevant FDA officials; and (c) to "touch base" with members of the academic community familiar with FDA. The process of obtaining the interagency agreement was also slowed by difficulties in reaching a consensus between ETIP and FDA about the nature and purpose of the proposed project.

A major communication problem developed between ETIP and FDA representatives. In retrospect, both ETIP and FDA viewed this language problem as part of a lengthy mutual education process. FDA representatives had to familiarize ETIP staff with the FDA way of doing things while ETIP representatives sought to ensure that explicit evaluation activities would be incorporated into both the

RFP process and the conduct of the experiment, and that mechanisms would be built into the RFP to foster continuing close interaction between FDA, ETIP, and the contractor throughout the course of the experiment. This mutual education was viewed by both ETIP and FDA as useful in defining their respective areas of concern, although some FDA officials expressed reluctance to endure another such language "hassle" as the price of ETIP experimentation.

At about the time that the substance of the proposed RFP was being approved by the FDA's Bureau of Drugs, the congressionally formed Joint Commission on Prescription Drug Use (JCPDU) became involved. One of the Commission's objectives was to encourage post-marketing surveillance for effectiveness (as opposed to ETIP/FDA's objective of monitoring for adverse effects). After initial FDA reluctance, it was agreed that representatives from the Commission would be included in the Project Advisory Group and that Commission concerns would be incorporated in management of the contract.

IMS America was awarded the contract to develop a prototype or "turnkey" method of post-marketing surveillance. In 1978 it became apparent no single method would work, and IMS and its consultants urged that several components would be necessary.

Meanwhile, pressure developed within the Commerce Department in 1980 to reduce ETIP funding of the FDA project because the amount budgeted but as yet unspent did not appear to critics of the project to match its prospects for reducing the regulatory lag imposed on the drug industry or for otherwise improving the climate for pharmaceutical innovations.

FDA's traditional drug approval process was carried out in three phases, involving gradually increasing sophistication of the adverse drug reaction information sought, gradually increasing numbers of patients being monitored, and gradually increasing spans of time. Post-marketing surveillance was carried out in some instances in a fourth phase. ETIP sought in its intervention to speed this process by using improved data-gathering techniques, by encouraging FDA to turn its existing practices into a "system" that would include critical self-evaluation, and by encouraging greater government-industry collaboration, including a post-Phase II safety review process to determine whether marketing of a new drug could commence prior to the beginning of the Phase III trials.

The late phase of drug investigation (Phase III) is the one in which the more difficult to find and more sporadic and unexpected adverse effects are sought. Because it was not clearly known how effective such Phase III trials were in finding these adverse effects or what precisely was learned from them beyond what was discovered in Phase II trials, a retrospective study of Phase III trials was started to determine what changes could be made in the drug-approval process. In addition, an industry-government safety review conference at the end of Phase II trials was added to the experiment. This conference was to bring together all information already gathered on adverse drug reactions and determine whether some types of information could better be gathered after marketing and which information could best be learned from Phase III trials. This addition to the experiment might lead to changes in the drug approval process which would result in earlier marketing, time-saving to industry, and greater drug-review effectiveness for FDA.

Retrospective reviews of the Phase III and Phase IV studies were planned. These and the safety review procedures at the end of Phase II trials promised to facilitate joint industry-FDA planning and to further reduce the "lag" and improve the climate for pharmaceutical industry innovations. These efforts were still in progress in mid-1982 when ETIP was closing down operations. FDA decided that post-marketing surveillance experimentation would continue under its own sponsorship. ETIP urged FDA also to continue funding on-site evaluation and outside-party facilitation of collaboration among industrial, governmental, and academic interests.

The potential linkages between post-marketing surveillance and technological change were still not fully tested by 1982. Still, ETIP could claim success for the project in that it sensitized FDA to both the process of administrative experimentation and to awareness of (and possible concern over) the ultimate technological impact of regulatory policies. Although at first there was little substantive concern evidenced at FDA for the impacts their regulations might have on technological innovation, there did seem to be a positive feeling for administrative experimentation among FDA staff and acknowledgement that without ETIP the issue of post-marketing surveillance could not have been addressed in such a manner.

More specifically, ETIP considered the project successful because it showed that much more was required in any attempt to improve pharmaceutical industry innovation than merely reducing drug-approval time. More important, ETIP determined, were the development of collaboration and communication on data bases among the parties involved and agreement on systems management,

both of which were ETIP-spurred ongoing efforts at FDA at the time of ETIP's termination.

3. FCC -- Public Record Message Service Deregulation (Project Nos. 140 and 161

ETIP first discussed ideas for communications deregulation in 1974. In 1976 the idea was revived and ETIP contracted TRANSCOM, a small firm specializing in communications regulation, to propose ideas for experimentation and to provide the expertise that would help "open doors" at FCC.

ETIP proposed (and FCC accepted in the project plan approved in August 1977) that the two agencies agree to experiment, allowing the specific nature of experiments to be worked out as opportunities and events warranted. Both moves, the contract with TRANSCOM and the program plan, represented departures for ETIP, which had heretofore selected specific experimentation candidates and hired contractors to flesh out experiment designs before signing interagency agreements. In this case ETIP relied on outside experts to suggest a range of ideas prior to the agreement to experiment.

FCC's response to ETIP's suggestions was favorable. Indeed, FCC staff proposed deregulations even more far-reaching than those proposed by ETIP-TRANSCOM, including one to open to full competition the public record message services (PMS) market, in which Western Union had enjoyed a monopoly since 1943.

In 1979 the FCC adopted broader entry and pricing regulations for PMS and resolved to monitor the deregulation's impact on the industry. FCC staff, ETIP, and its evaluability contractor, Performance Development Institute (PDI),

established a "stakeholders" group to develop a program for evaluating the changes and their impacts on the private sector. An evaluation design was agreed upon by the group in October 1980, and the following year the evaluation of the project was published by ETIP: "Toward Competitive Provision of Public Record Message Services?" The report concluded:[1]

- o While a few firms applied to the FCC and were approved to publicly offer record message telecommunications services on a nonsubscription basis, these services predominantly were oriented toward use by businesses, not the individual, occasional user.

- o Additional entry to the PMS market was a possibility based on the planned activity or past statements of several firms. Furthermore, the proliferation of subscription record message telecommunications services provided a potential basis for wider public service offerings in the future.

- o While development in PMS was slow-paced, business-oriented subscription record and data telecommunications and teleprocessing services became a kaleidoscope of activity. Even greater potential existed for new business and residential telecommunications-based services.

- o The development and extent of public availability and affordability of such new services were expected to be substantially influenced by the eventual outcome of debate over the proper structure of the telecommunications industry and the proper role of government in its regulation.

- o The uneven development of competition in the telecommunications industry raised issues about the maintenance, level, and redistribution of past subsidies among different telecommunications user groups and services.

- o Continued access to and the rates for telco local distribution plant, and the development of alternative local distribution telecommunications media seemed to be critical areas for further regulatory policy modifications to foster a pro-competitive environment.

In substance, the report showed that no further monitoring was warranted in the limited field of PMS because this field had become virtually indistin-

1. Derived from Op. Cit., p. III-3, Executive Summary, p. ii.

guishable from that of computerized telecommunication services. Instead, a system was needed for monitoring and assessing the telecommunications industry generally. ETIP agreed to assist FCC in developing the capabiity for ongoing measurement of technological and competitive trends in the "store and forward" computer communications market, but in its final months ETIP's objective pragmatically shifted toward the more modest goal of leaving behind within FCC an approach for developing and using information-gathering and asssessment systems as supports and guides in future regulatory decision-making.

That new technologies exploded upon the message-transmission industry could hardly be contested, but it was just as true that such innovation could not be attributed to deregulation of PMS. Still, the PMS industry did witness the beginning of competition in what had formerly been a monopoly. At least two firms (Graphnet and National IMS) entered the field, offering in one instance lower rates than Western Union Telegrams and in the other speedier service than Western Union Mailgrams. By 1982 Graphnet was reporting operating revenues of $15 million.

4. Marketplace and Government Results[1]

The link between ETIP regulatory activities and technological change in the private sector was admittedly weak. Although the experiments conducted were hypothesized to result in an improved climate for technological change in the private sector, with the possible exception of the FRA/ICC experiment with deregulation of fresh produce shipments and the subsequent use of advanced technology by the railroad industry, the cause-and-effect linkages were lengthy and

1. These concluding remarks are derived in part from Op. Cit., p. III-6, Kelly, pp. 78-79.

the time intervals over which industry could reasonably be expected to respond were greater than ETIP's lifespan.

The problem was not so much that the experiments had not stimulated new technologies. It was rather that, given its abbreviated history, little reason existed for expecting that ETIP could have determined what exactly were the effects of any of the modifications of regulatory processes on the rate and direction of technological innovation.

The complexity of the experimental environment and the relatively small magnitude of the experimental modifications relative to some of the political and economic variables intervening in the regulatory process are two major problems that regulatory change must overcome before conclusive policy recommendations can be formulated regarding the acceleration and direction of technological innovation that might result from regulatory experimentation.

What did result from ETIP experimentation with regulatory practices and policies in a number of instances was reduced costs to consumers. This was true both in the deregulation of the public records message services industry by FCC and in an additional project (No. 76, not considered in this report) which helped State public utility commissions significantly reduce the time required for rate-setting by using data-analysis techniques. This time-lag reduction subsequently allowed the regulated utility companies to introduce cost-cutting technologies.

More important than these marketplace results, however, was the raising of innovation-consciousness and the awakening of willingness to experiment with policy changes within the partner agencies with which ETIP worked. This consciousness-raising and the institutionalization of procedures to analyze the

likely impacts of current and anticipated regulations upon the course of innovation in the regulated industries occurred in virtually every agency with which ETIP's Regulatory Program Area worked, most notably at FDA, FCC, ICC, EPA, and the State utility commissions. These were direct and visible changes wrought by ETIP that are likely to have beneficial effects on both government and industry long after ETIP itself is terminated.

B. PROCUREMENT

The Federal government purchases an estimated $85 billion in goods and services annually. ETIP hypothesized that this immense purchasing power could be harnessed as an effective policy tool by providing new or increased demand for desirable technological change in those consumer and service industry goods of which the government was a major buyer. The government, however, had proven to be an uneducated bargain-hunter concerned almost exclusively with the immediate price tag of each item it purchased:

> ...(T)he government usually purchased the cheapest products that met minimal design standards. Not surprisingly, these products were also the simplest and most basic, incorporating technology that lagged significantly behind that available to private consumers. ETIP argued that if the government specified performance needs rather than design standards and purchased products with the lowest life cycle cost (initial price plus operating expenses), it would not only improve the quality of the goods purchased, but also, in the long run, save money. At the same time, this policy would encourage industrial innovation.[1]

ETIP identified three ways in which, if properly designed and implemented, government procurement activities could foster technological innovations and their diffusion into the marketplace:

1. Op. Cit., p. I-2, Britan, p. 56-58.

- The most direct impact government procurement can have is by applying its buying power to create a market for products and systems beyond the state-of-the-art. There are two major categories of government purchases in this area: purchases of innovations for government's own use, as by the National Aeronautics and Space Administration (NASA) and DOD, and purchases of innovations for use by society at large, as with technologies for meeting regulatory requirements imposed by such agencies as DOE, DOT, and EPA.

- Government procurement can create a demand "pull" for new technologies in the process of filling its routine requirements if it expresses its needs to industry in functional or performance terms. Such an approach would permit industry to exercise initiative and creativity in responding to these needs with innovative products and approaches. The size of the government market and its continuing nature would then serve as stimuli for industry to initiate developmental work.

- The government market also represents a sizable testing ground for innovative products. The ability to place new products in a field environment and monitor product performance can provide valuable information concerning product modifications, especially to regulatory agencies (e.g., DOE, DOT, and EPA) which had congressional mandates that required product innovation to achieve national objectives.

To attempt to harness these three procurement influences (market creation,+ demand pull, and prototype testing), ETIP identified innovative procurement procedures and contractual provisions to be tested and the potential administrative "targets of opportunity" for experiments, including FSS, the Veterans Administration (VA), and State local and governments. ETIP concentrated its initial procurement-area activities at FSS in experiments with the following innovative approaches to government purchasing:

- Life Cycle Costing (LCC): Determining total costs incurred over the normal lifetime of product use and substitution these lifetime costs in place of the initial low bid as the criterion for procurement award.

- Value Incentive Clause (VIC): Stipulation in procurement contracts that the manufacturer may share in cost savings to the government that result from innovative, efficient designs by the manufacturer.

- o Performance Specifications: Stipulation of improved product performance, rather than explicit design features, in describing government needs to industry. The manufacturer is encouraged to offer novel, low-cost designs so long as specified product performance standards are met.

- o Sliding Scale Rating: Used in conjunction with performance specifications, a technique that rewards manufacturers offering superior product performance by reducing their cost bid according to an established scale for purposes of determining the effective low bid.

- o Two-Step Procurement: A technique whereby manufacturers are asked to submit technical proposals (to establish the feasibility of innovation) prior to cost proposals. This technique was standard in the Federal Procurement Manual but was little used by many agencies.

- o Prototype Purchasing: A non-competitive means of allowing manufacturers to sell a limited quantity of an innovative product on the assumption that successful testing and evaluation of the product would lead to a larger government market.

ETIP's Procurement Area actively worked to test these incentives in several agencies for three years. Thereafter, the focus shifted to the process of administrative change within line agencies to establish a pattern of policy-induced technology change.

To conduct its procurement experiments ETIP developed formal cooperative agreements with FSS, VA, the National Institute of Government Purchasing (NIGP), and the National Association of State Purchasing Officers (NASPO). After a trial period of two years, the NIGP and NASPO arrangements were abandoned and, for a variety of reasons to be discussed later, the VA agreement proved ineffective in either conducting procurement experiments or in institutionalizing procedural change. The FSS agreement, however, succeeded in establishing LCC and VIC as routine procurement procedures. FSS Commissioner Mike Timbers, who began his tenure in June 1973, credited ETIP with a crucial role in getting the new new procedures adopted and standardized. The procurement agency now uses LCC

in many procurements, and internal policy statement requies that VIC be used in all contracts worth $100,000 or more.

The following sections discuss results of ETIP experimentation with LCC and VIC, and of an ETIP procurement project that tested the degree to which government procurement could support government regulations while simultaneously improving the climate for technological innovation. Also included is discussion of a procurement experiment with VA and subsequent retargeting of efforts to mission-oriented agencies with built-in incentives to foster technological innovation.

1. Life Cycle Costing (Project Nos. 36 and 63)

The Life Cycle Costing (LCC) approach to procurement is intended to obtain the best performance for the lowest total cost of ownership. Although major benefit to be derived from this approach was to be a reduction in overall cost to the government, it was hypothesized by ETIP that LCC also would stimulate among government suppliers a competition to lower the total-life costs of of their products by use of innovative technologies to lengthen the service life of products, to reduce their levels of energy consumption, to reduce maintenance costs. etc.

It should be noted again that ETIP's overriding purpose was not directly to bring about new technology but to gather information about those policies and mechanisms which might be expected to foster technological innovation and its diffusion. Nevertheless, individual projects did result in cost-savings to the government and in procurement of substantially improved, technologically advanced products. For example:

- o Water Heaters with substantially reduced energy consumption were purchased by FSS using both LCC and performance specification approaches. They were subsequently sold commercially. A reliable estimate placed savings to the government at about $2.3 million a year.

- o Air Conditioners procured using LCC had better energy efficiency than those procured previously using the lowest initial bid as criterion.

These procurements were among a long list of appliances purchased by the FSS using LCC based on energy costs of operation.

Another LCC project (No. 36) initiated by ETIP established for the Public Buildings Service (PBS) a comprehensive LCC approach to the analysis of options for meeting Federal space requirements. An LCC model was developed, computerized, and employed within PBS, but the relationship between the model and innovation was not identified, nor did the model establish a basis for policy recommendations to PBS or other agencies.

ETIP also took four practical actions to help agencies interested in the use of LCC:

- o It produced a "how to do it" manual;

- o It conducted training sessions;

- o It provided direct technical assistance for specific applications; and

- o It provided documentation of success stories that potential users could read.

2. Value Incentive Clause (Project No. 64)

The Value Incentive Clause (VIC) approach to procurement is intended to encourage contractors to share in cost savings accruing to government buyers from acceptable value change proposals (VCP's) made by the contractor. VCP's may affect costs associated with specification, design, material, process, tolerance,

packaging, or testing considerations, or product operation, maintenance, disposal, or replacement, as long as they directly benefit the government in the reduction of overall cost without impairment of quality or performance.

VIC had been used in other government agencies, notably DOD since 1962. ETIP and FSS decided VIC had considerable potential as a "best value" procurement technique and incorporated it into FSS purchasing in March 1974.

The VIC was formally instituted as a contractual clause by GSA and attached to all contracts of $100,000 or more beginning in June 1975. To acquaint FSS and industrial personnel with VIC, FSS held orientation seminars, prepared and disseminated informational brochures, and developed two video-tapes explaining VIC. Personal contacts were also made with a sample of 50 contractors by the FSS commissioner in an attempt to encourage response.

For this experiment the major intended impacts on industry from the FSS's perspective were to:

- Increase the value-for-the-dollar of government purchases during a contract as well as with each new contract, and to
- Encourage industry to recommend improvements in contract specifications, thereby giving industry a specific way of participating in a process to help the government continuously upgrade its procurement specifications and processes.

The major intended impacts on industry from ETIP's perspective were to:

- Provide an opportunity and incentive for companies to offer technological improvements in products they already had contracts to supply, and to
- Provide an incentive for the more innovative companies to bid (i.e., to obtain a guaranteed market for new R&D, thereby reducing the risk of R&D investment).

In FY 1976, the first full year of the project, an estimated 1,500 FSS contracts contained the VIC, but as of September 30, 1976, only 12 VCP's had been received by FSS. ETIP contracted with SRI International to determine why

the response had been so low and to obtain specific information that would help improve the VIC program. SRI reported:[1]

- Inclusion of the VIC in the contract and other promotional activity still often did not result in...(a) firm's awareness of the VIC option in an active contract held by the firm.

- Because of the complexity within FSS of using...(the) new contract vehicle, in the first year VIC was often not included in a contract and even more often included only by reference.

- In the relationship between FSS and industry, experience...(had) not yet instilled confidence in the firms...that a VCP submission would result in a positive outcome.

- Many firms...whose officials were aware of the option felt that the VIC was not applicable to their product and had not made any effort to explore the opportunty.

Nevertheless, in several contracts where the VIC was successfully employed by contractors, SRI considered the results mutually beneficial:

- FSS implementation of three changes in a contract for computer-type air conditioning units that had been recommended by the contractor saved the government $394,145 in installation, power use, and electrical demand costs over a ten-year period. The contractor's 20 percent incentive award share of an average year's savings added $7,882.90 to earnings on the contract.

- A contractor-suggested alternatives for a more efficient compressor and other changes contributed to higher quality computer-room air conditioning systems. Total estimated savings to the government in maintenance, power use, and electrical demand for the compressors were $378,510.80 over ten years. The contractor's 20 percent incentive-award share of an average year's savings to the government added $7,570.22 to contract earnings.

- The FSS implemented the major part of a VCP submitted by a contractor suggesting an innovative way of fastening the corners of household-goods shipping containers, thereby increasing their service life 400 percent. Ten-year estimated savings to the government exceeded $7.5 million. The contractor's incentive award exceeded $150,000.

1. "Commercial Impact Evaluation of ETIP Procurement Experiments, Phase I," Interim Report, SRI International, June 1978, p. 11.

- o A contractor's suggested changes to GSA specifications for wardrobe hinges saved the government $1.56 per wardrobe purchased and won the contractor a 50 percent award of $780 in additional earnings on the contract.

In the above cases, the government received considerable indirect savings as well as those listed, among them (a) updated specifications and concomitant continued savings for many years; (b) reductions in maintenance, operation, and disposal costs (as of scrapped shipping containers); (c) conservation of energy and other resources; and (d) reductions in future contracting efforts by requiring procurements less often in cases where the VCP's resulted in longer product life.

The cases also demonstrated "the capability of contractors to propose alternate methods for accomplishing a job in a more cost-effective manner by challenging government specifications which have become outdated due to advances in technology or improved methods and procedures. It also confirms the commitment of the...(FSS) to accept and implement good...(VCP's) and to return a fair share of the savings to the contractor who invests in making the effort to improve the product."[1]

Overall, however, the VIC was not the stimulus to innovation that had been expected, probably because contractors considered the share of savings returned to them as insufficient incentive. As a result, only a small number of the potentially applicable VIC's produced VCP responses, occasioning an expenditure of a great amount of effort for little gain.

1. See "Summary and Conclusions" (p. 1) of "Value Incentive Program, Computer Room Air Conditioning Units," July 1976; "Value Incentive Program, Energy Conservation Compressors for Computer Room Air Conditioning System," October 1976; "Value Incentive Program, Household Goods Shipping Containers," July 1976; and "Value Incentive Program, Reduce Welding/Brazing on Wardrobe Hinge," October 1976: Final Reports prepared for ETIP by Kempter-Rossman International, Washington, D.C. (NBS-GCR ETIP 76-23, 26, 18 and 17 respectively.)

3. Performance Specifications

Another way, it was believed, to enlist government procurement muscle in the service of stimulating private-sector technological innovation was to apply performance specifications (as opposed to the more traditional detailed product-design specifications) in RFP's that would dovetail with and otherwise buttress national policy on pending or forthcoming standards and other regulations. A case study that best illustrates the attempt to test this hypothesis, the problems encountered, and the chances for success was the procurement of low-noise lawnmowers by FSS.[1]

Power lawnmowers were chosen for the experiment because they were bought in large quantity, could be readily transferred to commercial markets, and were the subject of growing national concern regarding safety and noise.

In designing the experiment ETIP and FSS worked closely with EPA and the Consumer Product Safety Commission (CPSC), each of which was responsible for and interested in new regulations for lawnmowers: EPA for noise, CPSC for safety. Innovations were sought to reduce noise to 85 dB(A) from the standard industry range of 86-92 dB(A), and to introduce a "dead man's clutch," a safety device which would stop the mower's cutting action within three seconds after an operator released the handle.

The project plan elaborated the focus of this objective in its statement of evaluation criteria:

> The procurement approach will be judged effective...if and when improvements traceable to that mechanism are regularly offered in the private sector of the marketplace.

1. This case study is drawn in part from Op. Cit., p. III-6, Kelly, pp. 94-105.

It is evident from this that ETIP was interested principally in technology change rather than agency administrative change, at least at the launching of this experiment.

Neither EPA nor CPSC formally agreed to delay publication of new standards until results of the experimental procurement became available, but there was reason to believe some manufacturers perceived a relationship between the FSS lawnmower performance specifications and the performance standards being targeted by EPA and CPSC.

In September 1975, FSS issued a letter of intent to purchase 10,000 lawnmowers. Response was poor because industry was unable to solve the problem of a cheap, reliable clutch within the required time. This was in spite of CPSC's 1974 announcement of its intention to issue requirements for a "dead man" feature.

FFS specifications were issued that eliminated the "dead man" feature (but retained the noise-abatement feature) because CPSC stated that its safety standard was at least a year away. The specifications set the maximum dB(A) at 86, established a sliding scale whereby manufacturers offering 82 dB(A) would receive a $10 advantage in determining the low bid, and limited proposals to 4-cycle engine models, those most popular among industrial and other large-scale consumers.

Eight technical proposals were received. All were acceptable technically, but one was eliminated because it had been received after the deadline. The contract was awarded to AMF's Lawn and Garden Division of Des Moines, Iowa, in February 1977. When FSS tested a prototype of the AMF mower, noise emission levels of less than 80 dB(A) were recorded.

Significantly, the runner-up was a lawnmower also to be made by AMF which proposed noise emissions of 86 dB(A) and which cost $9.95 less per unit than the winner. The $10/unit bonus for improved noise-emission performance determined that the low-noise machine would be considered the lower bid by a margin of five cents per unit, a ploy AMF officials later frankly called "smart pricing."

In June 1977, GSA issued a news release implying that consumers would soon benefit from the availability of quieter lawnmowers, but AMF admitted it would not have manufactured such a mower had it not been for ETIP/FSS and questioned its marketability because it would cost more than comparable, noisier mowers and could not accept a grass bag attachment. AMF had no plans to market the machine.

As part of its evaluation of the project a DOC team headed by Thomas V. Kelly[1] interviewed officials of Seiffert Manufacturing Company of Kiel, Wisconsin, whose bid had been disqualified for tardiness, because its proposal had included a unique, workable "dead man's clutch" and a combination of noise emission (under 80 dB(A)) and cost ($82 per unit) which would have won the contract had it not been disqualified. (ETIP and FSS subsequently cooperated on purchase of 50 prototype Seiffert units to determine whether they met the technical claims made in the Seiffert proposal.)

A principal implicit incentive for industry response to this procurement had been the threat of regulation. Industry representatives had been resisting lower noise standards on the grounds that marketing experience demonstrated consumers wanted cheap machines that cut grass and were unwilling to pay extra for

1. Ibid.

noise reduction. EPA felt, as one manufacturer later corroborated, that a strong incentive in the ETIP/FSS experiment would be to provide a profit motive (10,000 lawnmowers x $10 bonus per unit) for industry to invent a substantially quieter lawnmower.

Seiffert, however, described its incentives quite differently. A small firm which manufactures and assembles lawn and farm equipment for other companies, it had no marketing network of its own but aspired to develop one. Six years earlier, when lawnmower safety had become a public issue, Seiffert had begun work on a "dead man's clutch" but shelved it because of difficulty in getting product liability insurance and because CPSC in 1973 condemned walk-behind rotary mowers as unsafe and threatened action. Seiffert was stopped short by regulatory doubt and concern that its device might work on a different principle than that which ultimately would be acceptable to CPSC.

When in 1976 Seiffert heard of ETIP and understood that ETIP had the blessing of CPSC, the manufacturer saw its chance to demonstrate to CPSC its invention in a powerfully persuasive way while simultaneously gaining momentum toward a marketing capability of its own. By coincidence, the design of the clutch which it had patented made the achievement of noise reduction a relatively simple and inexpensive modification.

Seiffert stressed that the indispensible factor was protection of proprietary rights. Had there been any chance that by responding to this procurement Seiffert would have lost its exclusive patent rights, its new lawnmower would have stayed on the shelf. Combining the opportunity to anticipate regulatory decision-making, initiate a market, and compete confidently for a short-range profit with the essential condition of protecting proprietary rights proved an irresistible combination of incentives.

It should be noted that CPSC subsequently issued proposed safety standards for walk-behind push rotary lawnmowers which incorporated a requirement for a "dead man" feature. Although the standard was published after the results of the ETIP/FSS experiment were available, CPSC officials disclaimed any real influence by ETIP other than adding marginal assurance to its belief that a cheap safety clutch was feasible.

As to noise-abatement standards:

> As long as noise control...was a high priority at EPA, the potential for a multi-product experiment was good and its potential value to EPA was high. When priorities switched to urban noise, Federal procurement experiments became somewhat less valued, and essential momentum in the idea was lost. With the shift in focus to NIGP and State level involvement, new actors/stakeholders became involved, and the decentralized experimental process soon followed.[1]

4. Veterans Administration (Project No. 80)[2]

ETIP Project No. 80 was not a single experimental project as such but an agreement between ETIP and VA to undertake experimental procurement activities for the VA medical system. The interagency agreement (June 1975) had the following objective:

> To implement and institutionalize within the VA Supply Service (VASS) the ETIP philosophy of using procurement as an incentive to stimulate innovation and technological change in the nation's health care delivery system.

Cooperation with the VA seemed a natural extension of ETIP's work with FSS. While FSS acts as a purchasing agent for a separate user population, the VA is both purchaser and user of medical devices.

1. "Procurement Experimentation in Federal Agencies, Phase III Final Report," Research Triangle Institute, May 1981, (21U-1689-FR) p. 44.

2. This section is drawn in part from Op. Cit. p. III-6, Kelly, pp. 107-116.

Following are examples of activities by the Experimental Procurement Office (EPO) established by the experiment:

- o Portable oxygen generator: This was an attempt to use performance specifications to spur a major technical advance in an extremely complex piece of equipment. It was unsuccessful except that one firm's proposal offered serendipitously a demand cannula (nasal breathing device) previously unavailable, which VA will purchase separately.

- o Urine specimen container: Performance specifications were used to obtain a modification of a simple non-mechanical device. Although the procurement was successful, it was not clear that VA hospital demand would put it to wide use.

- o Catheter cabinet: This was an unsuccessful attempt to convince industry to manufacture a specially designed cabinet which was devised in one of the VA hospitals.

The problems affecting ETIP activity within VA stemmed from many sources -- some structural, some conceptual:

Understaffing: EPO had at most only two staff members, one in Hines, Illinois, the other in Bay Pines, Florida, who quit the project in 1977. It is doubtful that one or even two persons could expect to have had significant impact on a system as large as that of VA.

Management Attitudes: High-level VA officials were tolerant but largely unimpressed by the efforts of ETIP in their agency. As time passed and few results were noted, managers told a DOC evaluation team[1] they saw no essential difference between the ETIP-sponsored EPO and the VA Testing and Evaluation Staff in which EPO was placed. Free staff and money were seen as the main benefits of ETIP intervention. While no animosity toward ETIP was expressed by VA officials, they did express an impatience with ETIP for not better defining its mission in VA.

1. Ibid.

Conceptual Ambiguity: One VA staff member expressed the view that ETIP started out backwards, concentrating on testing procurement methods rather than on identifying widely useful product innovations. As a result, time and effort had been lost experimenting with the standard but little used two-step procurement technique when there was no assurance that the product being solicited would be widely used even if it had become available.

In the case of the failed catheter cabinet procurement attempt, the typical ETIP approach of establishing a need for new technology and then experimenting with incentives to get manufacturers to produce an acceptable product innovation was reversed. In this case the innovation existed within VA and manufacturers were asked to produce it for markets which might or might not have existed.

Nature of the User Group: The VA hospital system is a loose confederation of semi-autonomous institutions staffed by medical and support professionals. The traditional independence of physicians as a professional group found its reflection in the resistance of hospitals to standardized equipment. Because of this, ETIP's operating assumption that VA acts as a single buying/using organization was in error. Many hospitals maintained their own workshops and constructed equipment of a design satisfactory to their own needs. Transfer of new designs from one hospital to others was infrequent and almost a majority of medical staff was invariably dissatisfied with anything VASS offered.

Industry Suspicion: Manufacturers were reluctant to devote resources to developing new products primarily for VA use because of the problem of predicting system demand and because field tests were required for every new device before an order could be placed for more than the initial test quantity. Thus,

VA could not guarantee a manufacturer that it would ever order a sufficient quantity of a new item to repay the manufacturer's R&D investment.

Before EPO could overcome industry's distrust it needed to devise an effective demand information system for medical supplies. The practical consequence of this was to force ETIP into the role of market research consultant for a closed-system Federal agency. Such a service by ETIP, however beneficial to VA and to ETIP in establishing the internal structure assumed in the initial decision to work with VA, was too removed from ETIP's missions as student and catalyst.

The VA/ETIP experimentation ended informally in 1979. It had proven frustrating and disappointing for both parties. With one minor exception, no experimental procurements resulted in innovative products, and it was openly questioned whether the learning process had been sufficiently illuminating to justify the interest and energy expended.

5. Mission-Agency Strategy

Based on its first several years' experience, ETIP recognized that procurement agencies such as FSS and VA do not have the marketplace leverage hypothesized nor the ongoing incentive to focus on technological innovation unless it results directly in savings. Budget-consciousness forced such agencies to seek the lowest bid possible first; technological innovation could at best be an ancillary benefit.

Because of these considerations ETIP moved the locus of procurement experiments into the larger, more mission-oriented agencies where there existed greater marketplace leverage and greater incentive to stimulate technological advance. Contracts were initiated with DOD, DOE, and EPA.

Examples of these subsequent efforts by ETIP and its procurement experimentation contractors, SRI International and Research Triangle Institute (RTI), include:

- o Major new technology purchases by DOD, such as of a new generation of Very High Speed Integrated Circuits, which bought into play "outside" firms and demonstrated the importance of major-user needs in fostering private-sector inventiveness;
- o The use of cooperative agreements in DOE-spurred development of energy-conservation technologies (e.g., solar energy cells); and
- o Prototype purchasing and testing by DOE (solar cells), the Postal Service (electric cars), and EPA (furniture coatings that use a low-emission water solvent process). (This latter demonstrated the use of government's procurement power to speed the achievement of regulatory goals by providing regulators with feedback on technical feasibility and reducing the level of risk to developers of the new technologies.)

6. Marketplace and Government Results

The marketplace spin-offs of ETIP's procurement experiments were admittedly modest. From the examples considered in this chapter, these included energy-saving appliances; cost-saving innovations in air conditioners, shipping container corner fasteners, and wardrobe hinges; and the Seiffert lawnmower.

More importantly, ETIP's procurement area initiatives significantly altered government agency perceptions and formalized procurement strategies designed to encourage development of advanced technologies.

- o OMB's Circular A109 put the government on record as favoring use of performance specifications in describing its system requirements to suppliers;
- o OMB's Office of Federal Procurement Policy (OFPP) adopted the performance specifications strategy for product procurements;
- o FSS institutionalized a range of innovation-encouraging procurement strategies, including LCC, VIC, and performance specifications; and

- o A number of agencies, notably EPA, DOE, and DOT, actively began pursuing procurement strategies to foster technological advances calculated to meet regulatory objectives.

(Although ETIP cooperated actively in DOD procurement initiatives, it could not take credit for ongoing, institutionalized strategies which had been used by DOD as early as 1962.)

C. ECONOMIC ASSISTANCE

During ETIP's first three years of operation Small Business and Research and Development were combined within a single program area that emphasized the R&D stage of the innovation process. It was hypothesized that small businesses, particularly those that were technology-based, faced special difficulties in attempting to develop new technologies and survive economically. ETIP, therefore, selected to examine government's role in either adding to or alleviating those difficulties.

By 1976 it became clear that the process of marketing the products of R&D should also be exmained to develop an understanding of the leverage various government policies could be expected to have at the various stages of the innovation process. R&D was separated out into a distinct program area and small business-oriented initiatives were incorporated within a new Economic Assistance Program Area whose mission was defined more broadly.

Whereas the Regulatory Area targeted specific attempts to lessen the negative impacts of government regulations on private-sector innovation, and Procurement Area experiments attempted to exercise the muscle of government purchasing to stimulate such innovation, Economic Assistance Area interests cut

across a range of government agencies and activities including direct aid by infusion of money and other assistance into the private sector (e.g., loans and subsidies), regulatory and other government actions believed to affect innovative firms and private infusion of money into them (e.g., securities regulations), and program options which could affect private sector initiatives in support of national policy in response to (or in anticipation of) international marketplace upheavals (e.g., countermeasure options for commodity supply shortfalls).

In this area ETIP functioned more as a student/researcher of what government can do than as change agent, although several of its studies did result in modified line-agency policies and procedures.

The following ETIP activities are considered in this section:

- Analysis of SBA mechanisms that could be used to facilitate private sector development and/or adoption of new technologies to meet regulatory requirements;
- Analysis of venture capital markets to determine whether a consistent pattern of under-funding of small technology-based firms existed, and development of a system to monitor for these and other effects arising from SEC regulations; and
- Funding and monitoring of an innovative program (the Connecticut Product Development Commission) to evaluate its effectiveness as a mechanism for injecting capital into private-sector technological development and to generate guidelines for future similar efforts.

This section examines these ETIP efforts in terms of what changes they effected in the marketplace and/or in government agency policies and procedures. The generalizable lessons derived from these studies and from others conducted by this program area (a case study of the semiconductor industry to examine the dynamics and effectiveness of a range of government policies; analysis of a variety of policy options to meet commodity shortfalls resulting from interna-

tional marketplace upheavals; and assessement of the efficacy of direct aid to private sector R&D through the granting of capital subsidies) will be treated in Chapter IV.

1. Regulatory Impacts on Small Businesses (Project No. 28)

Between 1974 and 1976 ETIP sponsored a series of studies in cooperation with SBA to examine how government could best support small, technology-based companies generally considered to be important sources of innovative products. This section considers the most significant of these studies.

Project No. 28 was a two-year effort by Charleswater Associates, Inc., (CAI) to identify and critically examine actions SBA could take to facilitate development and/or adoption of technologies forced on small businesses by government regulations and otherwise to alleviate problems small businesses face in complying with such regulations. CAI's final report[1] cited several difficulties small businesses face in complying with regulations. These included:

- o Fragmentation of regulations which affect small businesses;
- o Problems raising capital for "non-productive" investments in compliance technology;
- o A tendency to seek "end of pipe" rather than "process" solutions;
- o Difficulties in realizing economies of scale in complying with environmental standards; and
- o Lack of an effective "voice" in Washington.

CAI made the following recommendations:

- o "The single most cost-effective step" SBA could take is to "intervene in the Federal legislative and regulatory process as an active but objective advocate of small business needs and interests."

1. "The Impact on Small Business Concerns of Government Regulations That Force Technological Change," Charleswater Associates, Inc., September 1975 (GPA Stock No. 045-000-00144-0).

- o SBA should "expand its financial assistance activities (a) by aggressive use of its authority to provide comprehensive Regulatory Economic Injury Assistance loans, (b) by providing loan applicants with technical support for the preparation of applications, (c) by expanding its lease guarantee program to include guarantees for leasing the equipment and facilities necessary for regulatory compliance, and (d) by providing guarantees for bonds issued by small businesses."

- o SBA should "revive and expand" its technical assistance program by (a) maintaining a file of "as built" descriptions of compliance systems, (b) conducting management seminars on technical compliance problems, and (c) providing direct applications assistance.

- o SBA should foster cooperative action among small businesses and encourage (a) collaborative approaches to research and development of solutions to compliance problems, (b) jointly-operated production and pollution control facilities, (c) joint purchasing of materials and services to obtain the price advantages of mass buying power, (d) joint representation before regulatory agencies, elected officials, and the public, and (e) institution and defense of legal actions on a joint basis.[1]

As a result of these findings SBA increased its intervention in regulatory rule-making processes by upgrading and expanding its office of Chief Counsel for Advocacy and began working more closely with several regulatory agencies. Among the results of SBA and ETIP initiatives:

- o The Occupational Safety and Health Administration (OSHA) offered assistance and advice to small businesses for meeting OSHA regulations, and

- o EPA promoted among small businesses SBA's Economic Injury Loans Program, which provides relief to small firms suffering substantial economic injury as a result of environmental regulations.

Additionally, SBA institutionalized several other CAI recommendations. It began providing technical assistance to small businesses to enable them to understand better the technical requirements of new regulations, and its Technology Utilization Program established an inventory of available technology to

1. Ibid., pp. 7-9.

meet those requirements and began transferring this information to small businesses.

2. Venture Capital and SEC (Project Nos. 9 and 148)

Technology-based firms comprised an increasing proportion of company acquisitions being reported by U.S. corporations in the 1970s. Data from the Federal Trade Commission (FTC) suggested that these firms were unusually attractive targets for larger acquisition-minded companies. While the total number of mergers was declining, the number of technology-based acquisitions increased sixfold from 1972 to 1977, and the ratio of these acquisitions to all completed acquisitions increased 1840 percent. This raised serious concern about the reasons for such mergers and their possible implications for regulatory policy with regard to competition and efficient resource allocation in both product and capital markets.

The relative inability of private investors to gain liquidity in public capital markets led an SBA task force to suggest that

> large companies (are) able to entirely buy out successful small companies at a discounted price because the business...(has) little alternative in meeting (its) financing and liquidity needs. This is ...the major force increasing concentration....[1]

Concerned that these perceived inequities and imperfections in the venture capital markets appeared biased against technology-based small firms, in 1974 ETIP funded a study by Charles River Associates (CRA) to analyze capital markets and determine if there appeared to be any consistent patterns of underfund-

1. "U.S. Small Business Administration, Report of the SBA Task Force on Venture and Equity Capital for Small Business," January 1977, p. 19, as quoted in an SEC Draft Paper, "The Acquisition of Technology-Based Firms in the OTC Market," A.E. Osborne, Jr., March 16, 1979, p. 4.

ing of small technology-based firms. Small firms in seven technology-based industries were examined: drugs; office and computing machines; radio, television, and communications equipment; electronic components and accessories; aircraft, guided missiles, and parts; scientific and mechanical measuring instruments; and optical, medical, and ophthalmic goods. CRA reported:[1]

> We found no evidence of substantial market imperfections that restrict the flow of funds to small technology-based firms. We found no indication that small technology-based firms paid higher rates of interest or returned their unaffiliated stockholders more than other small firms. We found no indication that suppliers of funds to small technology-based firms earned higher profits than could be earned by investing in listed securities. We found no elements of the structure of behavior in the venture capital industry which would enable firms in the business to charge higher rates or earn greater profits than necessary to compensate for the risks assumed.

CRA added a caveat, however: failure to find imperfections did "not necessarily imply that the supply of funds to new technology-based firms (was) in some sense ideal" (p. S-2). Securities and tax regulations, CRA noted, did influence the rate of return required by suppliers of funds to those firms, and such regulations did "affect the profitability of small firms in general" (p. S-2).

CRA found, however, that regulatory changes that had been proposed could not be expected to increase the flow of funds to small technology-based companies by more than 10 percent, and that loan or investment guarantees to suppliers of funds or directly to small firms (also being proposed) could similarly increase the flow of funds by no more than 10 percent. CRA concluded:

1. "An Analysis of Venture Capital Market Imperfections, Executive Summary," Charles River Associates, February 1976 (NBS-GCR-ETIP 76-08) pp. S-1, 2.

> ...(A)ttempts to increase the flow of funds by direct government investment in small technology-based firms may tend to displace private funds rather than increase the total flow of funds (p. S-3).

The CRA report established ETIP credibility that opened the door to a joint ETIP-SEC experiment (Project No. 148) begun in 1977.

Both the Congress and SEC were already predisposed to do something about the burden of SEC regulations on small businesses when the project was initiated. In effect, ETIP did not so much "intervene" as present itself "at the right place at the right time." The project was two-phased. The first phase:

- Developed a quantitative model for estimating and evaluating the economic impacts of SEC regulations specifically directed at or having pronounced effects on the venture capital market; and
- Performed initial tests of the model by applying it retrospectively to existing regulations and on a real-time basis to both new and existing regulations so that its usefulness as a policy decision-making tool can be assessed.

The second phase:

- Extended evaluation of the monitoring system's efficacy by applying the model to several new or changed regulations over a sufficiently long period of time to allow measurement of all effects of securities regulation; and
- Institutionalized the monitoring system within the SEC's policy decision-making structure.

A number of studies were made of SEC policies (e.g., Rule 144, Regulation A) and general areas of concern (e.g., mergers and short sales) to identify venture capital problems where monitoring might be done. An economic input analysis model and the data bases needed to run the analyses were developed. In one case the need for data resulted in changes on an SEC form for small firms, and testing of the system contributed to deliberations over changes to Rule 144 that were favorable to small firms.

Rule 144 set minimum holding period requirements, restricted resale volume, and required resale notices when securities acquired in a transaction which did not involve a public offering were intended to be resold. It was an element of the disclosure system SEC administers as part of its effort to protect investors. Using the developed market model analytical system, the joint ETIP-SEC project monitored the effects of the rule after amendments in 1978 and 1979 relaxed its resale restrictions somewhat. Results of the monitoring provided an empirical basis for further amendments in 1981 when it was shown that the burden of filing Rule 144 notices might be lifted without adverse effects on the capital market environment for small, venture capital-backed, high-technology firms.

In Phase II several lines of work were developed:

- Institutionalization of the system,
- Closer ties to other SEC units,
- Increased attention to impacts other than issue price, and
- Broadening of the scope of the system to include other important stakeholders in the venture capital environment.

The Phase II monitoring system focused on policy-relevant issues affecting firms of all sizes, but its primary intention was to compare the effects of SEC regulatory activities on the smaller, innovative companies with effects on all companies. Thus ETIP's objective, the gathering of policy-relevant information about the securities markets confronting small issuers, was preserved.

The computerized data base and library and the skills to use it were being fully institutionalized in 1982 as an integral part of SEC's rule-making process and had already been employed successfully in monitoring for the effects of several information-gathering forms and regulations. Additionally the model had

been expanded to include other, non-SEC data bases, including the Federal Reserve System's Flow of Funds data.

In its final report on the project,[1] SEC praised the program's accomplishments and institutionalization:

> The versatility of the monitoring capability is...an important characteristic, since successful institutionalization of empirical analysis at the Commission requires the timely presentation of useful, policy-oriented information as often and on as wide a variety of regulatory issues as is possible. The individuals who are the "clients" of the system, primarily the Commission itself and the senior staff of the Commission's various divisions, change periodically, and thus the status of the monitoring capability should not be dependent on particular individuals.

To be effective, the monitoring system not only had to collect and apply correctly the relevant economic data and tools, but had also to develop channels of communication within SEC and see to it that the results of economic impact analyses reached decision-makers in an understandable and usable form so as to have an effect on decision-making. This was successfully accomplished.

3. Connecticut Product Development Corporation (Project Nos. 32, 78, and 136)

Another set of venture capital projects conducted by ETIP consisted of fact-gathering by Charleswater Associates, Inc. (CAI) that combined elements of economic aid to small business and research and development.

The Connecticut Product Development Corporation (CPDC) was the first attempt on the part of a quasi-public body in this country to inject what are essentially venture capital funds into product development. CPDC was to finance development of new products with state bond funds and to receive payback

1. "A Monitoring System for Effective Regulation of Venture Capital Markets, Final Report," U.S. Securities and Exchange Commission, Directorate of Economic and Policy Analysis, October 23, 1981, p. 15.

through royalties on sale of successfully completed and marketed products. Thus, CPDC was "to fill a perceived imperfection in the capital market by providing financial assistance when none was available from the private sector."[1]

Stymied in its earliest years by State administrative delays and court challenges, CPDC sought funding from ETIP, which agreed to contribute $300,000 for investment in projects in return for access to CPDC records and clients for five years.

Following is a sampler of CPDC-funded projects monitored for ETIP:

- Development of a machine to count and sort paper currency according to denominations;
- Development of an inspection system using a laser beam to scan bearings during the quality control phase of production;
- Development of concrete railroad ties for sale to Amtrak for its northeast corridor renovation;
- Development and marketing of a line of cookware designed for use in microwave ovens;
- A failed attempt to develop a "surgical zipper" -- a suture device designed to be applied to a patient's body prior to surgery in order to reduce resulting scar tissue; and
- An attempt to market a diesel engine fuel trimmer to reduce marine engine fuel consumption by a lengthy sea voyage aboard a prototype ship that ended when the ship sank in a storm at sea and both crew members, including the company president and prime mover of the project, drowned.

CPDC was monitored from 1975 to 1979 by CAI to determine the operational viability of the organization in its natural environment. Emphasis was placed on defining issues, problems, and possible application of the concept to other areas. CAI's final report, submitted in March 1980, included a number of

1. "Monitoring of Connecticut Product Development Corporation, Final Report," Charleswater Associates, Inc., March 1980, p. 10.

guidelines for CPDC-like operations. Those interested should refer to the final report of the project (see footnote on preceding page).

4. Marketplace and Government Results

None of the Economic Assistance Area projects could be said to have directly generated product innovations or their diffusion in the marketplace, with the possible exception of those products invented and marketed with the aid of CPDC and, indirectly because of its partial funding of CPDC, ETIP.

Still, the Economic Assistance Area did succeed in institutionalizing ETIP-like processes and perceptions within both SBA and SEC. Policies and procedures were modified and it was generally believed that the modifications improved the environment within which private-sector innovation takes place.

D. RESEARCH AND DEVELOPMENT

The most direct way in which the Federal government influences the course of technological growth has traditionally been through programs in support of research and development (R&D) and their concomitant demonstration projects. Thus, ETIP's efforts to examine and intervene in these Federal activities represented its single attempt to modify and experiment with government processes that could directly impact the process of technological innovation in the private sector.

The February 1974 Program Plan listed three questions to be addressed:

- What are the criteria for Federal funding of civilian R&D?
- What R&D partnership arrangements involving Federal funding speed the flow of R&D results into wide commercial use?
- How can Federal R&D funds catalyze industrial R&D?

To answer these questions ETIP entered into two types of activities -- studies of the R&D process to derive answers to the first question, and specific R&D projects to test hypothetical answers to the latter two. The studies and their findings will be considered in Chapter IV. This section focuses on two specific R&D projects:

- o A demonstration project to spur commercialization of a known technology (Integrated Utility Systems); and
- o Funding of R&D that applied consortium techniques to an attempt to develop a commercially practical technological innovation (fabric flame-retardants).

1. Integrated Utility Systems (Project No. 67)[1]

The basic concept of Integrated Utility Systems (IUS) is that integration within a single unit of five utility subsystems (electric power generation, heating and cooling, solid waste disposal, sewage treatment, and water supply) permits recycling of energy and materials that result in cost savings, fuel and water conservation, and increased environmental protection.

In 1973 the Office of Facilities Engineering and Property Management (OFEPM) within HEW began considering large-scale IUS applications for medical and educational complexes. Lacking implementation funds, it sought them from ETIP.

The project's purpose was to provide an experimental environment in which the goals of private enterprise might be aligned with the goals of a specific Federal program office to achieve:

- o A demonstration of the efficiency IUS in one major area of application;
- o Specification of appropriate changes in perception, custom, and law which presently act as disincentives to commercialization of IUS technology; and

1. This section is drawn from Op. Cit., p. III-6, Kelly, pp. 153-169.

- o The capacity and incentives within the participating private firms to pursue IUS installations independent of further Federal initiatives.

To realize these objectives, the plan proposed the hiring of an applications contractor "having an interest in commercializing IUS technology."

> The contractor's willingness to cost-share would be one important criteria (sic) in the selection process. Cost-sharing implied that the contractor's firm cannot profit from the architectural and engineering (A&E) effort alone, and that his incentive to participate will be derived from his perception of the future market for IUS hardware.

Contractor cost-sharing was vital to ETIP's initial interest in the project because traditional government-funded demonstration projects too often had resulted in commercially impractical hardware that was not subsequently transferred to the private sector. The cost-sharing provision was dropped, however, when the initial RFP drew disappointing response because, it was pointed out, cost-sharing in effect required that the contractor work without pay and because it violated engineering's professional code of ethics against fee-splitting.

Shifting the project's focus occasioned an internal ETIP correspondence (May 6, 1975) in which the ETIP project monitor, Richard Penn, explained what ETIP stood to gain from the activity as modified:

> ...(In general when the Federal government wanted to induce innovation in the non-governmental sector it has traditionally provided all or at least a large faction of the funding needed for the first use of the (new in context) technology. Here we propose only to fund the development of what we believe will be a sound (and convincing) argument that will lead to a decision to proceed on an innovative course by a university or medical complex. The government has pointedly told potential hosts that they should <u>not</u> look to the Federal government for any funding for the actual construction. If the decision to proceed is made, then it will be shown that the Federal government can cause an innovation at low cost to the government where the ecnomics provide a clear case to the <u>user</u> to innovate. What we are doing is reducing the front-end cost to the user to reduce his before-decision outlay where there is perceived risk to the user because it has never been done before.

Instead of "information intervention" being used to supply information to industry so that the IUS technology would be "pushed" through private-sector marketing, in the experiment's reformulation information from the feasibility studies was intended to stimulate demand for the technology on the part of potential users. If the stimulated demand was sufficient for one or more of the potential sites to build an IUS, then the government would have effectively "demonstrated" the technology for only the cost of the feasiblity study. ETIP would have acted as a "facilitator" rather than the traditinal government role of direct funder of R&D.

The University of Florida and Central Michigan University were selected as host sites for the feasibility studies, and Reynolds, Smith and Hills (RSH) was chosen as applications contractor. Both universities made "good faith" commitments to proceed with design, construction, and implementation of the IUS installations if the feasibility studies demonstrated the systems' economic and technical viability. Following successful feasibility studies, both universities also decided to seek funding for construction.

Additionally, the project was extended to include an IUS feasibility study (also successful) for the City of Burlington, Vermont, which includes both a university and a major medical center. This was a deliberate attempt by ETIP to test the usefulness of such feasibility studies in more complex organizational environments.

ETIP's IUS project could not yet be said to have directly stimulated diffusion of a new technology. At ETIP's termination, construction had not yet begun at any of the three proposed sites, although the city of Burlington had provided $9 million in municipal bonds for the project and appeared prepared to move toward actual construction of the IUS facility.

An initial aim of the project was to develop "the capacity and incentives within the participating private firms to pursue IUS installations independent of further Federal initiatives" (June 1974 Project Plan, cover letter to Assistant Secretary Ancker-Johnson). Although it did not seem to occur as a result of the incentives included in the original plan, several individuals and contractors have since been promoting and/or marketing the IUS concept.

In summary, although the IUS project had not yet led to actual implementation, it contributed significantly to information about and promotion of IUS technology. In view of the long lead times often required by projects of the magnitude of an IUS installation, this could be considered a significant contribution.

2. Flame-Retardants for Polyester/Cotton Blends (Project Nos. 7, 97, 125, 126, and 134).

In 1972 the Congress appropriated funds for an expanded fire, textile, and fabric-flammability research program. ETIP was chosen to organize and monitor the effort. This effort moved in tandem with a push for promulgation of a flammability safety standard by the Consumer Product Safety Commission. In June 1974, ETIP contracted for research and development of a commercially practical process for rendering cotton/polyester apparel fabrics flame-resistant. Because of the complex nature of the problem it seemed unlikely that any single laboratory or company could succeed in developing an appropriate commercial solution within the two years deemed necessary for adequate and timely consumer protection. For this reason the novel approach of assembling a consortium of interested and experienced R&D organizations was employed.

The consortium, headed by Clemson University, included participation by the University of Maryland, Research Triangle Institute (RTI), the Polytechnic

Institute of New York, the Southern Regional Research Center of the U.S. Department of Agriculture, the Hooker Chemicals and Plastics Corporation, the American Enka Company, and United Merchants and Manufacturers, Inc. The Dow-Corning Corporation joined the consortium in May 1975.

The project had two objectives, product development and evaluation of "the feasibility of stimulating commercially important technological innovation through the organization and Federal subsidization of a consortium of academic, industrial, governmental, and private non-profit research laboratories."[1] Evaluation was to be based on the degree of success or failure in achieving the technical objective of product development.

Evaluation of the project was done by Richard A. Rettig of The Rand Corporation under Project Nos. 97 and 134. Rettig assessed the consortium's performance in terms of research results, commercialization results, and the lessons learned about consortia as an R&D management approach (to be discussed in Chapter IV).[2]

Research: Basic knowledge about polyester/cotton blends and flammability was advanced by good quality applied research that developed data which helped the industries involved make R&D decisions. Differences of opinion over these results were found among consortium participants and observers, however. For example, some felt the results replicated previous results, others that several significant areas had been missed, and others that the research was not well tied to previous research (pp. 20, 21).

1. "Development of Flame Resistant Cotton/Polyester Fabrics," A Proposal Submitted to the U.S. Department of Commerce by Clemson University, Department of Textiles, May 16, 1974, p. 4.

2. "The Use of Consortia for the Management of Research and Development: The Clemson University ETIP Flammability Project," Richard A. Rettig, The Rand Corporation, December 1976.

Commercialization: "The project did not result in a commercial system for flame-retarding polyester/cotton blends. On this there is no disagreement.. One view, advanced by the consortium leadership, is that several candidate systems of potential commercial value have been identified and deserve further exploration by the private sector. The polar extreme is that no new systems were identified except one presented at a Clemson symposium by the Sandoz Corporation, a finish developed independently of the consortium and not yet fully evaluated" (p. 19).

Rettig pointed out, however, that between these two extremes a wide range of other opinions was held, including that industry never did expect commercialization and that the true worth of the project was "cross-fertilization" that will have an indirect impact on future product development for commercial markets (pp. 19, 20).

A major factor impeding development of a commercial product throughout the project's history had been uncertainty as to whether the CPSC would in fact promulgate a flammability standard and what such a standard would require.

Management: Rettig lauded the way the consortium had been organized, managed, and supervised. He pointed out, for example, that without continued government (ETIP) support consortium members "would not have been prepared to participate in its activities, primarily for antitrust reasons...(p. 5). While some participants expressed a preference for a stronger government role in technical supervision, most were of the view that the light (governmental) hand on research enabled that work to be determined within the consortium and facilitated greater learning about the consortium pattern of organization" (p. 6.).

In general, Rettig found, "The consortium participants, and most of the non-participating observers, expressed the general opinion that the consortium was well managed, a sound concept, and deserved serious consideration as an instrument for confronting other problems shared by government and industry" (p. 21). He also listed several guidelines for future improvements in consortium-building. These will be considered in Chapter IV.

3. Marketplace and Government Results

ETIP's R&D Program Area efforts succeeded in bringing IUS technology into the marketplace, if indications in 1982 were correct that actual construction of such facilities would proceed at the targeted institutions. Further, although the consortium approach failed actually to result in a new technology for fabric flame-retardants, it appeared to have advanced the state of the art, demonstrated the viability of the consortium approach, and resulted in guidelines for similar future attempts.

Perhaps more importantly, guidelines generated by ETIP for use in structuring and/or approving budgets for demonstration grants (as a result of its studies of Federally funded demonstrations, to be discussed in the next chapter) were adopted by EPA, ERDA, and OMB. These changes in government agency perceptions and practices resulted directly from ETIP's collaborative efforts with these agencies. The guidelines are listed in Chapter IV of this report and can be reviewed in greater detail in the final report by the Rand Corporation, "Analysis of Federally Funded Demonstration Projects," April 1976. (See footnote, 1 p. IV-26.)

E. CONCLUSIONS

This chapter has discussed a wide range of ETIP activities and the "products" they generated and disseminated -- whether those products were "things" or processes. The intent has been to highlight the impacts of these ETIP activities from each of two perspectives: that of the private-sector market-place and that of government line agencies.

1. Marketplace Perspective:

Few technological innovations were diffused into the general economy as a direct result of ETIP experimentaion.

- In the regulatory Area only the FRA/ICC experiment was found to have directly stimulated diffusion of advanced technologies in the private sector, but even there the long-term effects of deregulation on the railroad industry remained unclear.

- ETIP had almost all of its few successes in stimulating technological innovation in its Procurement Area activities, though again actual diffusion of innovations into the marketplace was limited. Life Cycle Costing, Value Incentive Clauses and the use of perfor mance specifications did result in substantial savings to government purchasers, however, and in some cases the innovative products purchased were commercialized. Only one minor product innovation, on the other hand, resulted from the long effort to introduce the VA to innovative purchasing techniques.

- The direct marketplace impacts of ETIP's Economic Assistance Area activities were admittedly negligible, if they existed at all, unless one included those inventions brought to market by entrepreneurs aided by CPDC, itself operating in part with ETIP funds, but it should be noted that ETIP's role in that project was limited to monitoring CPDC's activities and developing a set of guidelines for future, similar endeavors.

- The "product" most likely to find general use as the direct result of ETIP's intervention in R&D is the Integrated Utility System (IUS). By the closure of ETIP in late 1982, two universities and the City of Burlington, Vermont, were preparing to construct IUS facilities and a number of entrepreneurs were marketing the concept. Additionally, if flame-retardant fabrics someday find their way into the marketplace, it may well be at least an indirect result of ETIP's innovative work in establishing a consortium to bring such technology closer to commercial development.

It should be repeated, however, that although ETIP was frequently judged on such a scorecard, diffusion of technologically new products into the marketplace never had been its primary objective. Rather as Rettig pointed out in his discussion of the consortium to develop fabric flame-retardants, the proper role of government becomes the central question when commercialization is made the yardstick:[1]

> (O)ne should be clear that there are two conflicting images of the public interest in commercialization. One image is of the "baton" of R&D results generated by Federal government-sponsored research being passed, as it were, to the private sector for rapid exploitation. The contrasting image is of the baton being carried up to the fence demarcating the limits of government responsibility and being dropped on the other side. In the light of this second image, the non-exploitation or slow exploitation of results by the private sector need not be regarded as a failure but can equally be understood as informed decision-making.

It is more appropriate to guage ETIP by its achievements as an agent seeking to promote process changes within governmental line agencies that are likely to spur or, at the least, alleviate adverse effects upon innovation.

2. Government Agency Perspective

As an agent seeking to awaken government agency sensitivity toward technological innovation and to alter government procedures and policies which affect it, ETIP's record is considerably brighter.

- o In the Regulatory Area it (a) achieved deregulation of the public message communications industry by the FCC, a step which resulted at least to a limited degree in the introduction of competition into what had hitherto been a monopoly; (b) achieved deregulation of refrigerated and intermodal rail transport by the ICC, heightening that agency's appreciation of the need for stakeholder participation and economic impact analysis in its processes; and (c) institutionalized ETIP perspectives at FDA, EPA, FCC, and State utility commissions that may eventually impact the pace and direction of innovativeness by industry.

1. Ibid., p. 29.

- In the Economic Assistance Area it designed and institutionalized a system for monitoring the economic impacts of regulations on the venture capital market. Additionally, as result an of ETIP study, SBA altered its policies to help small business meet regulatory requirements.

- In the Research and Development Program Area it secured adoption of its demonstration grant funding guidelines by EPA, OMB, and ERDA.

IV. ACHIEVEMENTS -- ETIP AS STUDENT OF CHANGE

ETIP was created because it was discovered in the early 1970s that almost nothing was known about how government policies and activities affect the development and diffusion of new technologies. Its express purpose was to fill that knowledge gap by learning how to alter government agency activities so that they might foster technological innovation. In the course of its ten years ETIP made important advances toward that knowledge-building goal.

Although the strategy of administrative experimentation was intentionally problem- and agency-specific and therefore not designed to develop generalizable answers, the repeated experiences of ETIP did in fact lead to some anwers which appear applicable across the several government activities considered. Others, however, address themselves exclusively to the individual program areas. This chapter considers both sets of answers.

A. GENERALIZABLE LESSONS

The overriding generalizable lesson ETIP learned was that the interplay of government and industry is far more complex than was believed in 1972. Many more factors are involved than merely a two-sided equation of government spur and industrial horse, factors which derive from marketplace forces which, given a free enterprise system, government actions can at best only modestly influence. If government is to have any significant impact on the course of technological innovation and its diffusion in that marketplace, it must be continuously sensitive to those marketplace forces and be willing to experiment continuously

with its policies and procedures so they might be designed to work with them. In effect, government must recognize it can do much less as a spur that merely seeks to jolt the economy into action than it can if it adopts instead the role of one more horse harnessed to that economy alongside developer, producer, and user groups.

Under this umbrella lesson, obvious once learned but far from obvious at ETIP's beginning, the following more specific lessons were derived about government's proper role in influencing technology innovation.

1. Long-Term Commitment to Experimentation

Because of the complexities involved, considerable time, money, and care need to be spent in experimenting with government policies and procedures if those policies and procedures are to be modified in a way that is both valuable and credible to government and industry decision-makers. Effective policy changes must be based on far more intricate field-data gathering and analyses than is usually believed necessary. Any agency which seeks to promote change in government policies and procedures, whether a third-party agency like ETIP or the line agency itself, must make a major commitment to this effort. This was noted particularly in the ETIP-FDA experimentation in post-marketing drug surveillance, but was also true across the breadth of ETIP-facilitated experiments.

2. Stakeholder Collaboration

ETIP's strategy of involving all relevant stakeholders in each experiment from the outset proved invaluable in overcoming what would otherwise have most likely proven to be resistance by one or more parties, be they line-agency

personnel entrenched in traditional procedures and unwilling to risk failure (a risk implicit in any change) and therefore the disfavor of superiors, or industry decision-makers accustomed to viewing government intervention with suspicion.

It was learned (for example, in the experiments to deregulate rail transport and public message services) that extensive and careful studies conducted collaboratively with all private and public parties at stake can spark government agency actions that will foster technological change.

Additionally, it was found that if these preliminary studies are guided by recognized experts in the substantive area being considered for experimentation, and if those experts understand and appreciate the role of change agent, the studies are most likely to succeed in breaking down traditional stakeholder barriers by building credibility for the experimentation. In turn, the resulting credibility and sensitivity to the need for change bodes well for the experiment itself and for the likelihood that the results of the experiment will subsequently be incorporated within government agency policies and/or procedures.

Once experimentation is decided upon, based on preliminary expert studies and field interviews with all stakeholders, those stakeholders should be involved continuously in a consensus group, thus assuring continuing feedback as to the effects of the experimental change. This strategy was followed successfully in a wide array of experiments. It afforded flexibility, mid-course "fine-tuning," and results both tangible and credible to stakeholders. In effect, stakeholders became partners in the change in order to achieve each his own objectives (sometimes but not necessarily divergent) rather than perceiving themselves as victims of the changes being wrought.

3. Interviewing for Expectations

At the outset of each experiment with government change experimenters are best advised to interview all stakeholders, public and private, to determine their expectations. Arraying these expectations helped ETIP clarify the sets of objectives being sought from its experiments and determine whether those objectives were in fact realizable in the field. Continuous evaluation of the experiment by similar methods assures that those objectives continue to be realizable or, if they are found not to be, allow for sensible, data-based mid-course corrections.

4. Protection of Proprietary Rights

Development and diffusion of new technologies necessarily involves new-product patents which developers of those products wish to protect in order to assure their profitability. Too often private-sector developers distrust government intervention because of public disclosure laws that threaten these proprietary rights. Mechanisms should be built into the experimentation -- whether in government procurement, in the gathering of feedback data from regulatory change, in the dispensing of financial or other government assistance to private-sector developers, or in the support of research and development efforts -- that assures developers of new technologies that their right to profits from their endeavors will be protected. This was found to be a major factor in those ETIP projects which involved private-sector developers, for example in the experimental procurement of low-noise lawnmowers which one manufacturer said he responded to precisely because his proprietary rights in the innovation were assured protection.

5. Top-Level Commitment

Government agencies attempting to experiment with changes in policies and procedures should assure that top-level decision-makers within the agencies are committed to the experimentation to keep political and other pressures off agency experimenters and to avoid the disruptions all too likely in any effort that is as long-term as administrative experimentation must be.

This lesson was repeatedly driven home in the FDA project to develop post-marketing drug surveillance and in the FCC and ICC experiments with deregulation. It was also one of the hallmarks of the disappointing failure at experimentation with VA procurement that this lesson had not yet been adequately learned.

6. Recognition of Agency Needs

Line-agency personnel and decision-makers have varying needs from any given experiment with change. All these needs should be addressed in the design of the experiment with change if it is to result in tangible and credible policy and procedure modifications.

Operational staff need both basic and advanced economic input from the experiment if it is to assess adequately the experiment's impact on the private sector. Complex analysis models need to be developed and employed for evaluations of field data in order to provide decision-makers with valid policy recommendations. Those decision-makers, however, need simple, descriptive data on the economic impacts of current and proposed policy and procedure changes, rather than the elaborate analyses that undergird that data.

The lack of sufficient and appropriate economic data was found even within such a financial community-oriented agency as SEC, traditionally a lawyer-

dominated institution that emphasized the legal aspects of investor protection but gave little recognition to the economic benefits and costs of its actions. When it did use economic information-assessing tools, they were conventional and generally inappropriate to the needs. The ETIP-SEC project demonstrated that:

- o Conventional economic tools cannot be applied directly to policy analysis, and
- o Even when an agency collects considerable useful data, the data are typically not usable until both the collection and formation are tailored to the needs of the policy-analysis model.

From these lessons it was derived that, because the data needed were not always available from the reporting forms collected by the agency, modification of those forms and collection of information from outside sources were both required. SEC implemented both recommendations.

Additionally, sophisticated economic and computer-model training of agency staff was demonstrably needed if the analytical model was to be institutionalized, and that staff also had to develop the language skills to communicate the findings of their data-monitoring and evaluations to policy-makers in a simple, descriptive, and useful way if those evaluations were to have any impact on the policies being set. SEC also implemented these actions.

7. Real-Time Monitoring for Effects

In experimenting with policies and procedures, government must monitor for the effects of its experiments during the course of the experiment. The value of this lesson was brought home to ETIP in project after project. For example:

> ...(R)eal-time monitoring...(of CPDC by Charleswater Associates, Inc.) was able to provide very specific details on CPDC activities, progress, and problems as these occurred. This not ony enabled ETIP to learn about CPDC but also undoubtedly made it much easier to develop the guidelines for CPDC operation which ETIP wanted.[1]

Retrospective analyses, while necessary on occasion, can never match the benefits to be derived from real-time monitoring. Such monitoring, however, makes it necessary that the design of the experiment include data components that can be collected as the effects of the experiment take place. Furthermore:

> ...(T)he experimenter must try to keep faithful to recognized standards of measurability so that at the end of the trial questions about cause and effect can be answered. An experiment should not be launched unless those involved are convinced that the process can be measured and that the data will be credible. Needless to say, such "proof" is an everyday question during the experiment as well as in the design stages which precede implementation.[2]

B. PROGRAM AREA LESSONS

1. Regulation

Government's regulatory policies and procedures significantly affect private industry's willingness to venture into the innovative technologies. This truth was borne out not only in ETIP's interventions in government regulatory agencies but in procurement, economic assistance, and R&D experimentations and studies as well. Further, the significance of regulatory actions was found to be one set of complex interactions woven within the overall complexity of government-industry relationships.

1. Project Overview, Project No. 78, August 7, 1981.
2. Op. Cit., p. II-6, Kelly, pp. 167-168.

The complexity of the environment within which ETIP experiments with government regulation had to be carried out necessitated particularly heavy commitment of ETIP staff, as noted especially in the six-year experimentation with post-marketing surveillance of prescription drugs.

Following are more specific and interrelated lessons derived from ETIP's experimentation with government regulatory powers. (They are also derivative of more general lessons already discussed.)

Market Mechanisms vs. Command/Control

ETIP determined that a market-mechanism approach to regulation is both feasible and more desirable than the traditional command/control adversarial mechanism in which government adopts a standard of behavior and imposes it upon the private sector and is then forced to take on the role of policeman. Rather, by adopting market mechanisms that involve private-sector stakeholders, regulatory agencies can enter into a collaborative process that will lead to more effective and realizable standards less likely to stymie industry innovativeness. This was the strategy being successfully employed in the FDA experimentation with post-marketing drug surveillance at the closure of ETIP.

Regulatory Doubt Can Impede Technological Advance

While impending regulation may serve as an incentive for private industry to develop technologies to meet the proposed regulation, it also serves a forceful disincentive to the marketing of innovative products when there is doubt as to the direction, content, and timing of forthcoming regulations.

In at least two ETIP projects development of new technology was in response to regulatory "push": the procurement experiment which resulted in government

purchase of prototype low-noise lawnmowers from a supplier who entered the competition precisely because he saw a method of marketing a product that would meet forthcoming standards, and R&D experimentation with fabric flammability-retardants, which was focused directly upon an attempt to develop a product that would meet proposed safety regulations. However, in both cases doubts about the imminent regulations also operated counter to new-technology objectives.

Regulatory experiments themselves were generally aimed more at deregulating industry so as to remove impediments to innovation (e.g., experiments with FRA/ICC and FCC) and, as in the cases of FDA, EPA, and OSHA, eliminating the unnecessary burdens of regulations. In each case these activities appeared to be factors which would improve innovativeness in the marketplace. Economic assistance experimentation (e.g., with SEC and SBA) also had to consider regulatory impacts and were directed at alleviating the more deleterious of those impacts upon private-sector innovativeness. Whether in fact these government modifications did foster innovations in the private sector required monitoring beyond the span of ETIP's years.

Technology Drives the Regulatory Game

As witnessed in the project to deregulate public message services, technology provides the impetus for regulatory action. The rapid rise of new communications technology in this case forced the FCC to examine its policies and seek changes that would adequately reflect real-world events.

Further, ETIP determined that docket-bound agencies (like FCC), in which policies are made as issues erupt or are put before them, would be better served by an ongoing capability to monitor and assess trends in the industries to be regulated so as to anticipate regulatory policy needs.

2. Procurement[1]

Evaluations of its procurement experiments by ETIP contractors (SRI International and Research Triangle Institute (RTI)) generated a number of lessons about the ways in which government's purchasing power can influence the rate and direction of private-sector innovation.

In general, ETIP concluded that:

- The use of LCC in Federal procurement can induce incremental technology improvements in product design as well as substantial savings in energy and costs, as demonstrated in FSS purchases of energy-saving appliances;
- The use of performance rather than design specifications in Federal procurement can induce technological innovation among potential suppliers as demonstrated in the procurement of low-noise lawnmowers; and
- The use of VIC in Federal procurement contracts did not result in widespread use of the clause by suppliers or in subsequent innovation, though it could be argued that this was due to provision of insufficient incentives.

More specifically, ETIP contractors identified the following elements to be considered in any attempt to employ government buying power to influence private-sector innovative behavior.

Product and Industry Development Stage

The single most important factor both SRI and RTI found to be influencing whether procurement strategies are likely to affect technological advance was the stage of maturity of the product and of its industry. They discovered that the use of procurement strategies appears most promising when the objective is

1. This section is derived largely from Op. Cit., footnote 1, p. III-27, and from "Commercial Impact Evaluation of ETIP Procurement Experiments, Phase I and II," and "The Impacts of Federal Procurement on Industrial Innovation and Agency Purchasing Effectiveness: A Framework for Measurement and a Synthesis of Knowledge," by SRI International, both dated March 19, 1979.

to stimulate major innovations in the early stages of development. SRI reported that:

> The stage of product/industry development sets the context within which procurement incentives must operate.... (T)he opportunities for greatest impact on technology and product characteristics occur when the industry or product is young, and when products are in the early stages of the product life cycle.
>
> ...(At the stage of product innovation) when alternative designs are being evaluated (by industry), policy incentives, including procurement incentives, have the greatest chance of producing fundamental changes, since once development goes beyond this stage, the design parameters become more rigid and the cost of making design changes becomes greater.

In the case of FSS's procurement of energy-conserving appliances, for example, SRI found that the products being bought were "mature" and that only slow and uncertain advances in their technology could be expected to result from procurement strategies.

> ...(A) great many more parameters have been identified as being at work in (these) LCC experiments.... The number of confounding influences potentially at work in explaining a single LCC impact (on mature-product innovation) raises a significant challenge to experimental design....

A procurement strategy more likely to succeed in such circumstances, it was learned, would be aimed at achieving incremental product changes.

Government As Major Purchaser and End User

Federal procurement's influence on private sector technological advance can be expected to be most effective when government is itself the end user of a product being purchased, thereby reducing market uncertainties. In such cases, RTI identified three factors at work to improve a procurement experiment's likelihood of succeeding:

- As user, government understands its own requirements;

- o As user, government can communicate those requirements directly and accurately to potential suppliers; and
- o Suppliers recognize that government's presence in the market is long-term rather than the short-term presence reflected in such cases as prototype purchasing of products intended for general market distribution.

Government As Middleman or Broker

The contractors found, however, that when government is not the primary consumer the opposite circumstances operate and the resulting procurement contracts usually have features that act as disincentives to technological innovation. Chief among these are provisions for termination at the convenience of the government and unilateral changes in the scope of the work, leading to marketplace uncertainties.

The large share of risk shouldered by the developer of a new technology is often too large to add the non-market risks of government involvement. In these conditions, RTI concluded, some form of assistance by government to the private developer is often appropriate. Such cooperative agreements would allow "both parties...to contribute toward the desired goal, namely development and diffusion of a particular technology."

Sensitivity to Commercial Market Strategies and Perceptions

Procurement strategies aimed at stimulating industrial innovation can be effective when they are congruent with commercial market strategies. Both sensitivity to the nongovernment marketplace and techniques for effective communication with industry need to be developed, SRI concluded. Procurement strategies will succeed in influencing industry's decision-making only insofar as they are perceived to alter the developer's profits by:

- o Increasing revenues from the firm's innovative activities;
- o Lowering the costs of innovative activity; and/or
- o Lowering the risk associated with innovative activity.

Additionally, government procurement strategies should recognize that the changes private industry is able to make in its products are limited to available technological knowledge unless the industry undertakes major restructuring of its R&D activities. This will severely limit a private developer's interest in responding to a procurement that seeks a technologically advanced product.

Government procurement agencies also should recognize that their objectives in procurement experimentation are often divergent from industry objectives. The most important determinants of operational appropriateness and feasibility of most procurement experiments to those within government generally appear to be measurement/testing and technological trade-offs, while product/industry stages of development, nongovernment demand, minimum economic data, and government regulation appear to be the factors most important to industry in any new-technology procurement exercise.

The disappointing experiment to apply VIC to FSS procurement was a case in point that illustrated the results of incongruence between government and supplier orientations. The experience demonstrated that publicity and training alone are apparently not enough to induce increased use of VIC because the large-scale effort to communicate VIC provisions to FSS personnel and suppliers did not result in many VCP's from suppliers on subsequent contracts:

- o Innovative products were more likely to be bid on the contract in the first place, rather than brought forth during the term of the contract;

- o Contracts tended to be too short for innovations to take place;
- o The cost of preparing VCP's was to be shouldered by the supplier, thereby adding cost and risk; and
- o Suppliers were concerned that their innovations would set the standard for the next procurement, thereby revealing a supplier's innovative product and reducing competitive advantage.

(It could be argued, however, that the relative failure of experimentation with VIC to arouse a significant level of response was due to its failure to offer sufficient rewards for development of innovative, cost-saving products.)

Procurement Used in Tandem with Other Policy Tools

When used in conjunction with other Federal government policy instruments, notably its regulatory powers, procurement experiments aimed at achieving technological advance were found to have improved chances of success.

This was particularly noted in the effort to purchase low-noise and safety-designed power lawnmowers, in which the procurement effort was intended to support regulatory trends. (However, it should be noted again that regulatory lag and uncertainties could just as easily have frustrated the experiment.)

User Roles in Development and Use of LCC Models

A different set of lessons were derived from ETIP's experiment with the Public Buildings Service (PBS) to design a comprehensive LCC approach to the analysis of options to meet Federal space requirements.

Several factors contributed to the success of the project, however limited:

- o The model was developed within PBS and thus the owner of the new approach was in control;
- o The project leader in PBS was dedicated to model development;

- o The computerized model significantly reduced calculation times for PBS space requirements studies; and

- o Government-wide policies supported in general the ideas of the LCC model and its use in PBS.

Its institutionalization was hindered, however, by other factors, including failure adequately to involve important stakeholder groups:

- o The model was developed by a staff group rather than the real users in the appropriate line group;

- o Users were not directed by superiors or attracted by the project leader into a role of close support for project development;

- o The model was based on data not available at the time in PBS;

- o The model attempted to rationalize and influence a process which also involved political, economic, and design issues not wholly related to LCC considerations, thus limiting the model's ability to influence the process;

- o Users were not trained to operate the model; and

- o The model was not fully supported by top management in PBS, which was still examining how to apply LCC to PBS policies at the close of the project.

3. Economic Assistance

In addition to those studies and monitoring efforts already discussed in Chapter III, ETIP's Economic Assistance Area also conducted three efforts to develop knowledge about the role government does and can play in influencing the pace and direction of private-sector technology by direct infusion of economic aid and/or by ameliorating the environment to improve the chances of private-sector infusion of such funds:

- o A case study in which a range of government policies affecting a single industry (semiconductors) were examined to determine the relative effects and importance of different policy mechanisms and to assess the dynamics of policy impacts such as the timing of a policy's implementation relative to the stage of the given industry's development (Project No. 167);

- o An examination of the impact of Federal subsidies on seven industries (Project No. 93); and
- o An assessment of various options available to government (including support for new private-sector technological initiatives) to determine which mechanisms could best deal with major socio-economic disruptions in commodity supplies caused by international cartel-induced shortfalls (Project Nos. 15, 17, 130A, and 132).

The lessons derived from each of these, along with those derived from Economic Assistance projects discussed in Chapter III, are summarized below.

Industry Strategies and Government Policies

In Project No. 167 Charles River Associates, Inc. (CRA) examined the history of the semiconductor industry from its infancy in the 1950s when there was extensive interaction between government agencies and the industry because of government's interest in space and military applications and a consequent willingness to fund R&D, through the industry's early maturation in the 1960s when government demand decreased rapidly relative to total demand and resulted in a more laissez faire attitude by government, to the industry's full maturity in the late 1960s and in the 1970s when government tax and trade policies played an increasingly important role and led to increasing frustration by industry executives.

CRA drew these conclusions about the behavior pattern of the semiconductor industry and, by implication, of other high technology-oriented innovative industries:[1]

- o ...(M)ajor innovations do not necessarily cost large amounts of money, and much R&D spending in the semiconductor industry goes for incremental innovation (p. S-3).

1. "Innovation, Competition, and Government Policy in the Semiconductor Industry, Final Report," Charles River Associates, Inc., March 1980 (CRA Report #430.08).

- Top management involvement (in innovation) and a high overall level of risk-taking are closely associated with major innovations. In contrast, capital availability and R&D spending are more closely associated with incremental innovation (p. S-3).

- ...(S)trategic difference among firms...led to vigorous competition (the nature of which) changed over time. Typically, at the beginning of a new technology race firms placed strategic emphasis on major product innovation. In many cases this created opportunities for new innovative firms to enter the industry. Over time, as products became more standardized and sales volume increased, additional firms joined the race...(and) early participants sometimes left either because of innovation failures or because of increasing price competition (pp. S-3,4).

- ...(The strategy group) easiest to enter, specialized products with incremental innovation, exhibited the worst financial performance. The major innovation groups showed the superior financial performance.... Good industry performance is found to result from having a diversity of strategies. These include major innovation, incremental innovation, second sourcing, and aggressive pricing (pp. S-4,5).

From its examination of the role various government policies had upon this behavior of the semiconductor industry, CRA drew these conclusions about policy options:

- Government policy can have a direct effect on firms pursuing incremental innovation strategies due to the importance of capital availability and R&D spending...(which) are within direct influence of the government through its tax policies and interest rates (p. S-7).

- ...(Government influence on) firms pursuing major innovation strategies is much more indirect because the important variables influencing major innovation are top management background and commitment and a high degree of risk-taking. The major effect must come through policies that encourage people with the right talents and inclination to reach the top spots in firms that face the opportunities and have the organization to achieve major innovations (pp. S-7,8).

- ...(Policies which could have such indirect effects include) capital gains or stock-option incentives, minimal legal restrictions on personnel mobility, and low patent barriers (p. S-8).

- ...(F)ederal policy should attempt to put U.S. firms on equal footing with foreign firms in terms of capital availability and R&D spending in order to promote good international performance (p. S-8).

- o ...(A)n industry can be innovative without strong patent incentives (p. S-8).

- o Basic research appears to be important for innovation in the birth and childhood of an industry. However, as the industry matures, firms that do relatively little basic research can produce major innovations (p. S-8).

- o The relatively laissez-faire policy of the U.S. government (toward the semiconductor industry) in the last two decades has done a good job of encouraging major innovation, primarily through making it financially attractive for individuals and keeping legal barriers to entry and personnel mobility low (pp. S-8,9).

- o ...(P)olicies such as capital gains taxation need to permit a reasonable chance of striking it rich; competition will take care of the possibility that too much of the benefits of innovation end up in the pockets of the innovators (p. S-9).

- o ...(I)ndirect effects of (tax and trade) policies can be as important...to innovative behavior as the direct effects (of procurement and R&D funding) (p. S-9).

Impact of Subsidies on Technology

Major Federal subsidy programs gave an estimated $95 billion to private-sector producers and consumers in FY 1975. Because of the size of this direct aid, ETIP initiated Project No. 93 and contracted with CRA to study the effects of subsidies on seven industries and industry segments, their suppliers, and customers. The seven industries were municipal wastewater treatment facilities, mass transit, air transport, maritime transport, nuclear energy, health facilities, and technical publishing.

As with virtually all ETIP evaluations of government-industry relationships, CRA concluded that "the relationships among subsidies, capital formation, and technological change were closely intertwined with a larger set of economic relationships," chief among them government's regulatory policies which, in the

case of wastewater treatment facilities, "probably impeded technology change."[1] The basic conclusion of the study:

> Subsidies have had their most significant impact on technological change where they were a relatively important element in a set of coordinated government programs which had as their specific goal the development and commercial introduction of new technology (p. ix).

The subsidies studied, CRA found, did alter the quantity and quality of industrial output and in some cases also altered the mix of capital and labor in production. These changes in turn changed the rate and type of capital formation and technological change in the industries and their suppliers in varying degrees, and yet "no strong, specific relationship was observed between the subsidies and the rate or direction of technological change" (p. ix).

That is, even if a large subsidy succeeded in improving industry performance and its ability to raise capital, it was not enough to cause a discernible increase in the rate of technological innovation.

Another major finding by CRA: with only two exceptions "policy-makers apparently paid little attention to the possible impact of the subsidy programs on technological change or to the possible use of technological change to attain the goals of the subsidy program." As a result, "Policy-makers have missed opportunities to use technological change to help achieve the goals of the subsidy programs more effectively or efficiently" (p. ix). Citing the wastewater treatment facilities subsidy program as an example, CRA listed these shortcomings:

- The short period of time...didn't allow...newly developed technologies to be demonstrated, accepted, and incorporated into plant designs.

1. "Subsidies, Capital Formation, and Technological Change: Summary and Conclusions," Volume 8, Charles River Associates, Inc., May 1978 (CRA Report 302.19) p. viii.

- Massive short-term Federal commitment diverted R&D funds away from long-term development of innovative products and processes.
- Once the physical plant was in place the cost of using newer, more cost-effective technologies would be too high because that physical plant would have to be removed.
- Eligibility for certain subsidies "precluded a number of potentially innovative organizations from Federal economic assistance" (p. x).

To counter these shortcomings and failures of foresight, CRA developed a set of guidelines for policy-makers to help them determine whether government intervention is warranted in a given situation, at what stage of industrial activity the intervention should occur, and what form the intervention should take. The guidelines cover:

- Diagnosis of the problem, ranking of objectives, and analysis of the causes of the problem;
- Designing a subsidy program including selection between demand-side and supply-side subsidization;
- Distributing the costs of the subsidy between public and private sectors;
- Infrasructure requirements;
- Consideration of effects on industry and the marketplace;
- Matching the subsidy to the impediment;
- The relationship between the recipient industry and its supplying industries;
- Use of technological change as a policy instrument;
- The interaction between the subsidy and government regulation of the recipient industry;
- Experimentation with the subsidy to evaluate costs and benefits; and
- Monitoring of the subsidy program for its effects.

These guidelines can be found in the report cited in the footnote on page IV-19.

Policy Options for Commodity Supplies

In the 1970s the formation of international cartels to manipulate the flow and pricing of commodities (e.g., petroleum and bauxite) caused alarm that the U.S. economy might be crippled by shortfalls in important raw materials. It was believed that in some cases these shortfalls might be alleviated at least in part by technologically innovative remedies, such as development of synthetic fuels. Thus, the overall intent of ETIP's Commodity Supplies projects (Nos. 15, 17, 130A, and 132) was to determine what Federal policies were needed to deal with major socio-economic disruptions in those supplies where technological changes appeared to be an attractive remedy.

Charles River Associates (CRA) explored how various government strategies might protect against disruptions in the markets for seven minerals: alumnimum/bauxite, chromium, manganese, cobalt, platinum/palladium, petroleum, and copper. CRA concluded that high import-dependence, concentration of commodity supplies, or the existence of commodity cartels did not necessarily imply high risks for the U.S. CRA also found that:[1]

- o With the exception of chromite, stockpiling was not an appropriate government response to critical materials;
- o Some amount of stockpiling might be useful as minimal protection against short-term cut-offs, but stockpiles in private industry and/or government depots already met the need;

1. Derived from "Policy Implications of Producer Country Supply Restrictions," (nine volumes), February 1977, and "Commodity Supply Policies," August 1977, both by Charles River Associates, Inc. (NBS-GCR-ETIP 77-36 and NBS-GCR-ETIP 77-38 respectively).

- o Tarriffs, quotas, or subsidies were not desirable policies to reduce import dependence; they would create unnecessary costs to the U.S.;

- o Existing technology, which might provide a means of substitution for disrupted supplies, was an inefficient approach for the government to support, but R&D aimed at producing substitution technologies more in line with projected mineral costs might be an appropriate government effort;

- o Other policies might help alleviate the potential supply problems, such as encouraging conservation of minerals and ocean mining; and

- o Technical knowledge about substitute materials that might be used and other technical information that would be of value to users of raw materials is widely scattered. Information diffusion channels are inefficient, fragmentary, and sometimes inaccurate. As a result consumers of raw materials cannot effectively plan for potential sudden shortages and cannot participate intelligently in the development of Technical alternatives.

As a principal spin-off product of this report, CRA developed a computerized analytical framework for future critical material applications and for evaluating policy options, including supply- and demand-side technological options, stockpiles, tariffs, and subsidies.

Small Businesses' Special Problems

Technology-based small firms face unique problems in attempts to meet Federal regulations and remain financially viable. These include a lack of an effective "voice" in regulatory agencies and legislatures such as larger companies enjoy through trade associations and other vehicles; a lack of expertise in or access to and understanding of state-of-the-art technologies that could help them satisfy regulatory requirements; a traditonal concern for "end of the pipe" as opposed to "process" solutions to technological problems; difficulties in raising capital and realizing economies of scale; and fragmentation of regulations and regulatory agencies that affect small business. Because of ETIP's

initiatives, SBA addressed these problems by adopting several ETIP-generated recommendations for advocacy on behalf of and technical assistance to small firms.

4. Research and Development

ETIP's efforts to evaluate and intervene in Federal R&D and in demonstrations of R&D-spawned products were its only activities that appeared to have "the opportunity to modify and experiment with government processes that can directly impact the process of technological innovation in the private sector"[1] (emphasis added). And yet, as revealed in virtually every study by ETIP of Federally funded R&D, government's impact on innovation through such direct support has been greatly overestimated.

In part because of the relatively high visibility of government's supposed impact on innovation through R&D funding, and in part because such funding was initially intended to be at the core of ETIP's mission, it was in this field that ETIP's examination of traditional processes and attempts to experiment with those processes most directly led to a fuller comprehension of the complex interplay between private-sector innovativeness and government intervention. For this reason this section considers in some detail the "lessons learned" by ETIP about that interplay and how to improve its track record.

As six case studies conducted by Arthur D. Little (ADL) in Project No. 19 ("Federal Funding of Civilian R&D") demonstrated, Federal R&D funding is never enough to stimulate technological change in the private sector because such

1. Op. Cit., p. III-6, Kelly, p. 90.

financial support is only one among many factors which contribute to creating a climate conducive to change:

> R&D cost is a small part of the total cost of bringing technological innovation into the marketplace. This fact is often overlooked by Federal policy-makers in both the executive and legislative branches. It is one of the reasons why many U.S. companies with proven records of developing and marketing new products often shun Federal R&D funds and why so many Federal R&D products are shelved.
>
> The "mythology" of Federal R&D is derived largely from the success stories of the Manhattan- and Apollo-type projects. What is too often overlooked is that in such instances the government was not only the funder of R&D, but it was also the customer for the resulting hardware and systems.
>
> Now the government's role as customer is diminishing for a growing fraction of the R&D it funds. R&D targeted to the civilian sector has increased from 23% to 35% in the last six years. The new consumers are industry, local government, and private citizens. In these instances, the funder of R&D, the performer of R&D, the manufacturer using R&D-generated knowledge, and the customers are separate and autonomous elements related through the workings of the market.
>
> Government intervention in the marketplace may be called for when deficiencies in its workings are detrimental to the economic or social well-being of the country, (but) (m)erely funding civilian R&D is insufficient to correct those situations.[1]

ADL concluded that "policies for Federal funding of civilian R&D should be formulated in the larger context of the complex process of innovation." Weaknesses ADL found in government's traditional attempts to support R&D intended for the commercial marketplace included the following:

- Federal R&D policies have been mainly the result of decentralized decision-making by mission-oriented departments and agencies (p. 3).
- ...The process of innovation, involving the private sector as the agent for changes, was poorly understood by the Federal R&D funding agency....

1. "Federal Funding of Civilian Research and Development, Volume 1: Summary," Arthur D. Little, Inc., February 1976 (NBS-GCR-ETIP 76-03) p. 1.

- o (That) process is often not a linear, point-to-point process, in which each step is part of a systematic progression. Innovation is more adventurous, more spontaneous, and more opportunistic. The triggers are many. Government incentives can be triggers, provided that they are formulated with full knowledge of the private-sector environment...(p. 4).

- o There is rarely any Federal strategy aimed at propagation and application of research and development results in the industrial society. Indeed...the rules of practice for industrial participation in mission-agency R&D (may) create built-in barriers to commercialization...(p. 5).

- o ...(T)he ability of business to perform as the agent of technological change is dependent upon a very wide range of factors and influences which interact among each other: timing, perceptions of the market, the calculus of opportunity and risk, the objectives of the firm, expectations of returns, the structure of competition, and to some degree, the role of government wearing its several hats as policy-maker, R&D funder, and regulator...(p. 6).

ADL concluded that "Federal R&D funding policies must be formulated as one possible component in this complex framework of interacting factors which trigger the process of innovation, some of which are significantly influenced through government policies and actions other than R&D funding" (p. 6). High among these influencing actions are regulatory policies and procedures which, as ETIP learned from its Flammable Fabrics Consortium Project (No. 7), can add to the complexity and serve as a "confounding influence" when regulatory outcomes are uncertain. (From this experience ETIP identified a potential for increased interaction between R&D and regulatory activities.)

The following are other lessons learned by ETIP in its experimentation with and evaluations of Federal R&D and demonstration programs.

Technology Push vs. Market Pull

Government's principal shortcoming in its R&D activities was shown to be a failure to understand that technology was more likely to be "pulled" into the

marketplace by encouraging favorable conditions among potential users of the new technology than it was to be "pushed" into commercialization by government subsidization of technology producers. Stated another way, Federal incentives to create or aggregate a market for civilian technology are more appropriate than Federal funding of civilian-oriented R&D.

The ADL study noted that when Federally funded R&D efforts resulted in commercialization it was almost always because policy measures undertaken by the company developing the innovative product either caused or stimulated market demand. That is, inventions were most often "pulled" into the market by use of appropriate incentives, not "pushed" by the R&D itself.

From its investigation of 24 demonstration projects spanning a wide range of Federal agencies, technologies, and project characteristics (Project No. 11), Rand found that what was true for R&D was also true for Federal funding of demonstration projects. In its final report, Rand stated:[1]

> In the absence of a well-articulated market demand the pursuit of demonstration projects is an especially risky activity; whatever successes are achieved are accompanied by many failures.

ETIP explained its "market pull" strategy in the background briefing paper prepared for Secretary of Commerce Elliot L. Richardson:[2]

> Civilian research and development programs have been viewed by many people as the government trying to find practical uses for the technology it had developed. This was viewed as creating a technology push program. ETIP's view is that...(research can become) a technology pull process...(if) the problem definition activity... involves more deeply the ultimate user of problem-solving products being developed.

1. "An Analysis of Federally Funded Demonstration Projects: Final Report," Walter S. Baer, Leland L. Johnson, and Edward W. Merrow, April 1976 (R-1926-DOC).

2. "Experimental Technology Incentives Program: Background for a Briefing for Secretary of Commerce Elliot L. Richardson," 1976, p. 494.

Based on 46 case studies, SRI International developed and tested a set of 36 guidelines to help Federal R&D managers improve the commercialization of their results. The guidelines are distributed across stages of management from program planning and project selection to final project review and evaluation. They concern market planning and analysis, market intelligence and communication techniques, and selection and management of R&D performers. Of all the categories, SRI found that market planning and analysis factors had the greatest importance during planning and project selection. Most projects, SRI found, failed to include market analyses in these early stages and therefore failed to find market acceptance.

> Our findings indicate that the most important recommendations for improving the management of Federal R&D fall into two major areas: (1) Market Planning and Analysis, and (2) Market Intelligence and Communications Techniques. The first emphasizes the importance of orientating Federal R&D agencies to the marketplace and of designing projects to meet producer and user requirements rather than promoting a technology per se. The second stresses the importance of communications and cooperation among the various parties -- Federal R&D funding agency, R&D performer, potential producers, potential users, and other governmental and nongovernmental bodies -- whose actions affect the transition of R&D to the marketplace. Both sets of activities embody a philosophy of market responsiveness that current Federal practices make difficult to realize.[1]

SRI displayed its guidelines in matrix form. As noted earlier, "Market Planning and Analysis" had the greatest array of activities recommended to be undertaken in the program planning and project initiation stages -- further emphasizing the importance of "market pull" in the commercialization of innovations.

1. "Management of Federal R&D for Commercialization," Final Report and Executive Summary, SRI International, September 1978 (NBS-GCR-ETIP 78-58 and 78-57) p. 2.

Limited Value of Demonstrations

Federal funding of demonstration projects have limited effect on commercialization of R&D results. Such demonstrations, ETIP learned, had some marketplace effect only when:

- o ...(T)he principal technological problems (involved) had been worked out beforehand;
- o They "involved non-Federal cost sharing, while those funded entirely by the Federal government resulted in little or no diffusion."
- o They resulted from initiatives by private companies or local public agencies rather than having been "pushed" directly by the Federal government;
- o ..."(T)here were obvious manufacturers and purchasers of the new technology, and markets for similar products existed"; and
- o They did not face "externally imposed time constraints."[1]

Based on these findings, Rand drew the following conclusions about the appropriateness of demonstration projects and their characteristics that contribute to success or failure at diffusion:

- o Demonstration projects have a narrow scope for effective use. They are most effective when diffusion is hampered by lack of knowledge...(by) potential adopters about the use of the technology under commercial operating conditions. But demonstrations are appropriate only when these uncertainties are not large and when there is a strong rationale for Federal involvement.
- o Demonstration projects appear to be weak tools for tackling institutional and organizational barriers to diffusion. Other government interventions, such as changes in regulations or subsidies, may be more effective than demonstrations in stimulating diffusion in such situations.
- o Large demonstration projects with heavy Federal funding are particularly prone to difficulty. Heavy Federal investment tends to make projects highly visible and vulnerable to political pressures detrimental to success.

1. Op. Cit., IV-26, Baer, et. al., p. v.

- o On-site project management is generally effective. Whatever management problems arise are overshadowed by (the need to address) other more serious problems noted above.

- o Dissemination of information from demonstration projects is generally not a serious problem. When projects fail to...(be diffused commercially), they generally do so not because of weakness in the information network, but for other reasons noted above (p. v-vi).

Among the more important guidelines identified by Rand:

- o ...(T)he demonstration (should be conducted) on as small a scale and with as little initial visibility as possible.

- o ...(L)arge projects (should not be emphasized) at the expense of small ones involving incremental improvements to existing products or processes.

- o ...(P)olitical pressure to demonstrate before a technology is well in hand (should be resisted).

- o ...(E)nough time should be allowed in the project's schedule for slippage, especially...(in) large projects with significant technological uncertainty (p. vi).

Rand recommended an initial exploratory study to answer the following questions:

- o What is the rationale for Federal involvement in relation to ongoing private-sector activity?

- o In what specific ways will the project generate new knowledge or otherwise stimulate diffusion?

- o Who are the principal decision-makers in determining whether the new technology is adopted, and how will they be influenced by the demonstration?

- o What evidence is there of interest in the project among potential adopters or other target audience? (p. vi).

In planning and implementing the project, Rand recommended that:

- o Potential adopters and other target audiences, including regulatory agencies where relevant, help plan the demonstration;

- o Concrete planning be done at the local operating level with Federal review, and not by the Federal agency;

- o Demonstrations include cost-sharing by private-sector firms with incentives to diffuse the technology;

- o When demonstrations involve continuing experimentation, the distinction between these activities be made clear to potential adopters; and

- o Because demonstrations involve trade-offs among costs, performance, and time, the time element -- rather than cost and/or performance -- should be relaxed (p. vi-vii).

Other guidelines developed by Rand can be found in Rand's final report, "An Analysis of Federally Funded Demonstration Projects" (see footnote, p. IV-26).

Alternative R&D Strategies

The ETIP/HEW project to spur IUS applications at universities and hospital complexes demonstrated that government does have alternatives to heavy financial investment in R&D and demonstration projects. In the case of IUS, the successful alternative was provision of engineering and economic information rather than a massive infusion of funds.

> The implication of these findings is that under certain circumstances the government need not mount expensive demonstration projects but can leverage with rather modest amounts of funds the expenditures of capital funds by the users of the technology.[1]

The IUS project, however, did result in three operational "lessons":

- o The need for close supervision of and coordination with any cooperating agency to prevent, correct, or reconcile goal divergence during the conduct of the experiment;

- o The need for substantial support from upper management of the cooperating agency during the course of the experiment; and

- o The need for substantial support from upper management of the cooperating agency during the course of the experiment; and

1. Op. Cit., footnote 2, p. IV-26, p. 497. That "users" of IUS were encountering difficulties in securing construction funds could not be attributed to a failure by ETIP; rather, ETIP "succeeded" in securing commitments from these users because, even though it used its funds only to demonstrate the feasibility and practicality of IUS, it still secured commitments to build.

- The need for continued flexibility in the course of developing experiments and dealing with impediments that arise in the course of conducting the experiments.[1]

Consortium Viability

A consortium of individuals and institutions representing all interests in research and commercialization of a new technology can be an effective mechanism for directing government research funds toward practical marketplace uses in certain circumstances, as ETIP learned in its experience with a consortium to develop flame-retardants for fabrics. The ultimate failure to introudce a commercial system for flame retardation was due not to intrinsic shortcomings of the consortium approach but to technological limitations. However, ETIP learned that use of consortia must recognize and address certain difficulties:

- Substantial efforts are necessary if adequate communication among consortium members is to be developed and maintained;
- Problems of protecting firms' proprietary laboratory equipment and practices from the full public disclosure requirements associated with government funding must be addressed; and
- The antitrust implications of consortia are paramount in the minds of private firms and must be countered.

In his evaluation of the Clemson University consortium,[2] Rettig identified these major factors as influencing the project:

- Personal and professional characteristics of the project director, identified by many as "the critical factor(s)" in the consortium's success;
- Leadership located in a university department that had a strong interaction with the industrial community;
- Institutional incentives to participate, derived from "positive benefits and the absence of negative costs" and from the fact that "private firms inside and outside the consortium were actually involved in cost-sharing with the project";

1. Op. Cit., p, III-6, Kelly, p. 89.
2. Op. Cit., p. III-47, Rettig.

- Individual incentives to participate, derived from "preexisting channels of communication between the project director and the member representatives...which had previously contributed to familiarity, trust, and confidence"; and

- ..."(E)xtensive, if not extraordinary expenditures of time and energy for communication with consortium and non-consortium organizations alike," which assured a steady flow of information vital to such collaborative efforts.

Rettig also listed suggestions made by interviewed participants as to how the consortium might have been improved. The following are derived from those which appear most relevant to future attempts at R&D consortium-building;

- Total resources should not be fragmented among consortium members.

- Considerable attention should be given to early involvement of all stakeholders, in this case to include commercial fiber and textile firms, prospective users, other researchers besides chemists, and an advisory committee of nonparticipants.

- A planning period should precede the research project itself. This would facilitate project build-up after the contract award and make for better use of subcontract research work.

- Redundancy of research work should be allowed at the initiation of the project for definitional purposes, with severity exercised in the termination of less promising lines of work.

- A public meeting should be held to report initial results.

- More emphasis should be placed upon generating underlying scientific knowledge than on applied work.

- Efforts should be expended to integrate the results of the research with the appropriate body of scientific literature.

Rettig added a few "balancing comments" to the suggestions above:

- No attempt had been made to discount the bias of the participants he interviewed.

- The utility of acting on any of the above suggestions should be set against the costs of doing so; and

- His report was completed without circulation to the consortium participants and thus did not have the benefit of any critical reaction they might provide.

Several general conclusions were drawn about the values and limitations of consortia as mechanisms for R&D management. The values:

- Consortia may be attractive "where the resources...(to address a technical problem comprehensively) are not available in a single research organization and where the talents of several organizations can be easily assembled."

- Consortia may offer a sensible way to offest limitations in the capabilities of the Federal government for detailed technical management of a project.

- "Consortia appear to be of high value where it is important to facilitate the flow of scientific and technical communication across organizational boundaries. In the Clemson University project, university research groups became much more sensitive to the problems of commercialization...(and industrial firms developed) greater appreciation of underlying factors in flammability, information bearing both on short- and long-term work."

- "Increased communication...appears to be one of the chief values of the consortium approach." This was illustrated by the fact that private companies conveyed "more information...without threat to proprietary information than would be the case otherwise... (because of) personal knowledge of and trust in the individuals to whom such information (was) being transmitted" (p. 25).

The limitations:

- "Costs of coordination are high. These costs can be compensated for by energetic leadership committed to the task...(b)ut these costs should not be ignored or underestimated...."

- Consortia "may not facilitate collective participation in project management" when they are "of relatively short duration and geographically dispersed" because temporary organizations place "a premium on developing consensus and minimizing conflict.... (This) may incline such organizations toward risk-adverse behavior in scientific terms and inhibit boldness in the exploration of technical possiblities."

- "...(O)ne recurring problem will be the handling of proprietary information" (p. 26).

Rettig concluded that "a thorough appraisal of consortia...would require a comparative analysis of this approach with several other more traditional approaches."

Importantly, Rettig found that without active government intervention by ETIP the consortium probably would never have been organized because of anti-trust fears on the part of participating industrial firms. Thus, the consortium approach seems to require government-supplied incentives. Rettig cautioned, however, that such government action appears attractive only if "there is a clear public policy rationale for government intervention in the first instance. The desire to commercialize the results of government-sponsored research is not, a priori, sufficient policy basis for efforts to do so" (p. 29).

Political Sensitivity

A final caveat: ETIP discovered that experimenting with R&D involves "a relatively large commitment of resources...compared to the effort required to develop, say, a regulatory experiment given the current administration's interest in regulation reform."[1]

Throughout R&D experimentation and analyses ETIP witnessed the political sensitivity of Federal R&D funding issues. This included not only the potential for competition and rivalry among competing agencies and their theorists, "but also the reluctance on the part of those charged with implementing a politically popular Federal R&D program to experiment with that program (and, by implication, risk failure)."[2]

Even in a climate favorable to R&D, then, in which Federal policy actively pursues R&D results (as during ETIP's early years before de-emphasis in favor of regulatory experimentation), political considerations loom large for experimentation with R&D approaches. (This was also pointed out, as mentioned earlier

1. Op. Cit., p. III-6, Kelly, p. 92.
2. Ibid.

in this section, in the guidelines for demonstration projects developed for ETIP, in which the Rand Corporation urged that such projects be kept small and with low visibility in order to avoid "political pressures.")

V. CONCLUSIONS

In 1979 a panel of outside observers evaluating ETIP for the Department of Commerce circulated a report[1] which stated in part:

> As in any complex learning venture, the early work of ETIP was sometimes naive and clumsy, with false starts, wheel-spinning, and mistakes. They are inevitable elements in a learning process, and ETIP learned a great deal from both its successes and failures.

Thus ETIP, as an experimental program, was as much a student of its own activities as it was of other agencies. That is, it strove to learn about government-to-government activities that might most efficaciously induce change, and continued to learn from both its successes and failures until its termination. This chapter summarizes both ETIP's weaknesses and its strengths as factors that contributed to those successes and failures -- its weaknesses and strengths as perceived by those most directly involved. It closes with a summation of the answers to the three basic questions ETIP asked.

A. WEAKNESSES

The "weaknesses" derived more from the environment within which ETIP was required to experiment than from characteristics inherent in ETIP itself. Nor were the weaknesses by any means unanimously accepted as such by all participants and observers of the ETIP decade. Some could just as easily be considered as the necessary trade-offs of the more significant benefits to be derived from the very trademarks that gave rise to the "weaknesses." In either case, future experimenters with government policy would be wise to bear them in mind.

1. "An Evaluative Report on the Center for Field Methods," Evaluation Panel draft report, May 25, 1979.

1. No Overall Strategy

One of the most frequently cited flaws in the way ETIP carried out its mission was that it failed to develop an overall strategy which would tie incremental experiments together into a network to make the whole larger and more important than the sum of its parts. This resulted from ETIP's piecemeal strategy designed to achieve results of immediate practicality.

Although this was most true of ETIP's early years, mid-course corrections by ETIP in its later years were achieving their goal of coordinating an overall strategy. Had ETIP survived several years longer, it is possible this shortcoming would have been resolved, but this would have required a long-range commitment to systemization (as opposed to quick, popularly recognizable piecemeal results) on the part of both legislative and executive branch political leaders, a commitment lacking in the early 1980's.

2. Organizational Tug-of-War

The chief organizational difficulty that impinged upon ETIP's chances for success throughout its history took the form of a tug-of-war between those who wanted elaborate and lengthy research protocols and those who wanted quick results. The first suspected the second of politics and advocacy, considered anathema to ETIP's stance as neutral third-party facilitator-researcher, and the second disdained the former as "too academic."

Overlaid upon that difficulty, and in part growing from it, were repeated changes in management structure and leadership, which frustrated attempts to maintain the continuity needed for a coherent overall strategy.

3. The Pressure of Time

The average lifespan of an ETIP project was two to three years, too short a period to assure thorough testing of hypotheses and mid-course corrections, development of basic knowledge, or marketplace diffusion of new technology.

(A significant exception to this, and one which "proved" the point that significant results take time, was the six-year history of the FDA experiment.)

Particularly in ETIP's early years, the general strategy was to seek out and respond to overtures from those administrative agencies already eager for ETIP funds and/or expertise in order to improve their own internal efficiency or effectiveness. Such a strategy, while conducive to the production of "results" in the short-term deemed necessary for continued congressional support and funding, worked counter to those who saw need for the slower pace of rigorous application of scientific method.

4. Ill-Prepared Hypotheses

One direct result of the time pressures, felt most in ETIP's early years, was initiation of experiments to test ill-advised or incomplete hypotheses. This shortcoming was noted repeatedly. Hypotheses often were built on an incomplete understanding of the problems, a prime example being the hypothesis that post-marketing surveillance of drugs could provide a safety net for drug approval in such a way that early approval could be given and the climate for pharmaceutical innovation thereby improved. The FDA experiment demonstrated that changes in the drug-approval process, including industry-government collaborative approaches, would also be necessary if the experiment was to succeed.

5. Changes in Context

Changes in the context within which ETIP experiments were carried out (by design in the "real world" subject as it is to the moving targets of economic, social, and political shifts) further frustrated attempts to test definitively ETIP's originally stated hypotheses.

While ETIP's strategy of flexibility was adopted in recognition of these "real world" shifts, this flexibility did have negative effects as well as the beneficial ones already cited (e.g., stakeholder involvement for consensus and commitment-building). The significant negative effect was further frustration for those eager to build ETIP progress slowly and scientifically in order to produce valid generalizable answers to basic questions posed about government's impact on innovation in the private sector.

6. The Uncertainties of Behavioral Sciences

Generalizable knowledge about government's impact on innovation is not only not widely available but also is not likely to yield to ETIP's experimentation methods and constraints. This is true both at the level of the ETIP Program Area (e.g., the impact of government procurement on innovation) and at the individual project level (e.g., the impact of life-cycle-based purchasing on appliance technology).

The difficulty is one often encountered in studying human behavior and social systems. Both government program delivery and industrial innovation are activities which should be defined as social systems and social behavior, involving as they do such subtle and varying factors as human unpredictability, signals, incentives, etc. Such fields of endeavor have rarely been susceptible to methods of scientific inquiry.

B. STRENGTHS

Given these shortcomings, however, ETIP was remarkably successful in proving that the traditionally viewed "hidebound" bureaucracy can in fact be moved to change in an orderly fashion that minimizes risk and, more importantly, that the interaction between government and the private sector can itself be modified in a way that is credible and satisfactory both to those inside government and to those in the private sector.

Final evaluation of ETIP's program is properly a function of stakeholder viewpoints. The following is a selection of opinions about ETIP from such stakeholders -- those in government agencies who experienced firsthand the ETIP change process. It is by no means a scientific sampling, which would be beyond the scope of this final report, nor in any way representative of the spectrum of opinions about ETIP. Rather, it is an attempt to discover through these agency reactions what ETIP's assets were perceived to be by those directly involved outside ETIP.

1. Agency Responses

Food and Drug Administration[1]

> There is no doubt that this project has had a tremendous impact upon certain activities within the FDA. The project has clearly resulted in changes both within the agency as reflected by programs and actions, and also outside as reflected in some of the recommendations regarding PMS (post-marketing surveillance) we have received....

1. The following is extracted from a letter by Jerome A. Halperin, Acting Director, Office of Drugs, National Center for Drugs and Biologics, U.S. Food and Drug Administration, to Robert Parsons, Director, Experimental Technology Incentives Program, National Bureau of Standards, July 15, 1982; and from "A Policy Experiment in the Regulation of Human Drugs," by Jerome A. Halperin, Drug Intelligence and Clinical Pharmacy, Vol. 14, pp. 845-847.

> The 18-month gestation period for the first contract proposal was not all a "peaches and cream" consensus-building exercise. The process was more like the mating dance or porcupines, stylized and ritualistic, slow and careful. We found we had basic problems in vocabulary; we spoke a different language. Words like "system" that seemed to have simple meanings, meant different things to the FDA and to the ETIP....
>
> (I)t is essential that we state for the record that ETIP has been an effective agent of change. (Emphasis added). At the outset of the project we were told that ETIP was an organization interested in policy experiments with Federal agencies to determine if agencies could be provided with incentives to change their policies in ways to stimulate innovation. I believe without question that this goal has been met by ETIP in this project.... ETIP provided the incentive to cause the Bureau of Drugs to want to experiment in its own policies regarding post-marketing surveillance. The motivating force of funds (not otherwise available to FDA through its own budget) to do policy experiments unquestionably gave us the opportunity and the where-with-all (sic) to do things we would have liked to do but were unable to do otherwise. In addition to the funds, the brain power, interest, enthusiasm, and dedication of the ETIP staff members who participated directly in the project over the last six years and indirectly through its on-site evaluation contractor, PDI, have enriched our project advisory group's capability to design better projects, experiments, and studies; to evaluate and understand in a more meaningful way the results of these studies and projects; and to use this knowledge to formulate more rational, effective, and efficient policies regarding post-marketing surveillance and drug safety....

Federal Communications Commission[1]

In the 1979 report by ETIP's evaluation panel of outside experts, David A. Irwin of the FCC echoed Halperin's comments about "the mating dance of the porcupines" in describing the development of an ETIP-FCC partnership of mutual agreement, understanding, trust, and respect, and the value of that partnership:

> As a result of our work with ETIP, we have done some things we would not have done and have perspectives we would not have had.

1. This and the remaining sections of this chapter are derived in large part from Op. Cit., p. V-1, pp. 5-11.

ETIP, he told the panel, helped the FCC look at its processes during a turbulent period of technological growth in the communications industry and provided the means for assessment, evaluation, and prediction of what would happen next that would require or be ameliorated by FCC action.

Federal Supply Service

When a Department of Commerce evaluation team canvassed agencies about their involvements with ETIP,[1] FSS officials credited ETIP with providing support needed to maintain innovative purchasing procedures in the face of persistent opposition from tradition-minded staff. ETIP contributions cited as particularly valued included:

- o Funds. FSS found it necessary to seek funds outside its own budget to support experimental purchasing.
- o Technical Assistance. Although ETIP staff shortage limited the flow of technical assistance, FSS management officials found ETIP technical advice extremely valuable in starting the early LCC and VIC experiments. Operational staff, however, disputed the statement.
- o Leverage and prestige. ETIP's position as an outside independent agency helped FSS maintain its commitment to innovative procurement, inasmuch as decisions relative to that commitment could not be made entirely internal to the agency. In addition, ETIP's affiliation with the highly regarded NBS served to some extent to blunt suspicion of the experiments both outside and within FSS.

Securities and Exchange Commission

The SEC also praised ETIP's facilitator role in the effort to develop a data-gathering, monitoring, and analysis model within the agency. Citing results from its applications of the model, SEC reported:[2]

1. Op. Cit., p. III-6, Kelly.
2. Op. Cit., III-40, p. 8.

> The research findings, with the corresponding regulatory implications, obviously could not have been produced without the customized library of computer programs...(one of the components) of the monitoring capability developed as part of the ETIP joint project.

Office of Technology Assessment

John Young of OTA, who was involved with ETIP from its beginning, told the 1979 evaluation panel that ETIP's greatest assets were that it served as a non-threatening outside stimulus to line agencies, that it reduced the risks involved in doing something different, and that it provided both expertise and seed money for the development and assessment of innovations. He also noted that ETIP's placement in the NBS enhanced its nonthreatening character.

Young said OTA benefited from and relied on ETIP's work -- for example, on its design for cooperative agreements -- and described the relationship between the agencies as symbiotic. He cited the two agencies' mutual recognition of the importance of policy and administrative experiments and of addressing process and management issues. The significance of ETIP's work, he noted, rested partly on the fact that policy affecting innovation is being made all the time and needs to be monitored.

2. The ETIP Strategy

ETIP's approach was almost unique in the history of government, relying as it did on the building of collaborative relationships between agencies for the purpose of experimentation with policies and procedures. On the basis of its sampling of agency reactions to ETIP, the 1979 panel identified several principles which derived from this strategy and appeared to underly ETIP's effectiveness across a variety of activities. (No order of priority is implied in the following observations.)

Partnership

In many ways, ETIP behaved like a consulting firm with other agencies as its clients, but a more complete joining of ETIP's and the client-agency's resources resulted than would have been the case in the typical consultant-client relationship. For this reason, the relationship could best be described as partnership, a concept that extended to relations with project contractors, which were jointly selected and managed by the agency and ETIP.

Choice of Partners

Of the many kinds of experiments which could have been undertaken, ETIP selected those for which it could find a willing partner, the "target of opportunty" strategy. In applying this strategy ETIP joined with agencies which were willing and ready to work with it. This contributed much towards ensuring the success of ETIP efforts within an agency, and successes generated in this way enhanced and spread ETIP's reputation as a valuable resource, thereby contributing to the readiness and willingness of other agencies to accept ETIP as a partner.

Staff-to-Staff Collaboration

ETIP dealt with the concerned staff of other agencies and made no effort to acquire "authority" or "clout" by starting at the top or by other methods. Instead, ETIP earned its credibility in the process of building a relationship with a new partner, sometimes with the assistance of testimonials from other partners.

Seed Money

Even though the staff of a line agency may think that some changes might be desirable, it is often difficult to draw funds away from present uses into

uses likely to be perceived as risky or of uncertain value. ETIP's ability to fund explorations and experiments designed to determine more clearly the need for and describe more clearly the nature of contemplated changes was vital to the initiation of work with a new partner.

Out of initial collaboration evolved commitment of the agency-partner to the contemplated changes and to provision of its own money and staff for continuing the effort.

Non-Emergency Role

The process of building relationships, establishing the need for changes, identifying the potential changes needed, designing and implementing them, and evaluating the outcomes, was not a short-term undertaking. To see this process through, ETIP needed protection from being drawn into the role of fire-fighter or trouble-shooter. Its independent status within the NBS was of great help in maintaining such a posture (although, as has already been noted, efforts frequently were stymied by unrealistic time limitations nevertheless).

Transferral of Skills and Ownership

ETIP brought to its partners considerable skills in experiment design, technical analysis, and evaluation, as well as new perspective and the collaborative approach. Through its work with ETIP, each partner became familiar with these skills and became increasingly able to apply them itself. Thus ETIP was able to gain the advantages of a small team that could increase its impact by reproducing itself in its partner agencies.

Adaptability

Although ETIP devoted considerable effort to documenting its learning and sought useful generalizations, it refrained from using one model to approach

all problems. It was problem-centered and client-centered and was thereby able to adapt its approach to the uniqueness of each situation.

Modesty

ETIP refrained from taking over or telling a partner what to do. Instead, much as in a therapist-patient relationship, it worked with the partner in a problem-solving mode until both discovered what actions were needed. Similarly, ETIP did not use its knowledge and skills to keep its partner dependent but freely shared both knowledge and skills. Finally, ETIP did not seek credit for its partners' successes.

Development of Commonality

An important part of ETIP's expertise was knowing how to develop common goals, common language, common understandings, and common strategies with each of its partners and stakeholders. An example of the application of this knowledge was incorporation of the Joint Commission on Prescription Drug Use (JCPDU) and its agenda into the ETIP/FDA partnership and in the protracted pre-experiment negotiations in which the need for thoroughly briefing FDA personnel on ETIP's process and evaluation interests was addressed.

Synergic Strategies

ETIP avoided the use of adversarial strategies. It was neither advocate, nor activist, nor salesman. It recognized that the only source of creativity in the relationship lay in the differences between itself and its partners, and put those differences to work in developing new insights, perspectives, and strategies.

C. CONCLUSION

At the outset it was stated that ETIP could be assessed from each of three vantage points -- by how well it could answer each of three questions. Following, then, is a summation of ETIP's answers to those questions:

1. Did ETIP stimulate private technological initiatives?

New products that can be attributed directly to ETIP interventions in government-industry processes were admittedly modest in number and significance, but ETIP did demonstrate that monitoring the private-sector impacts of government activities and modifying those activities based on analyses of the results of that monitoring can and will foster private-sector technological advance.

2. Did ETIP alter government agency policies and procedures?

Institutionalization of monitoring for private sector impacts, of evaluating those impacts, and of basing incremental policy and procedure changes on the results of those evaluations was institutionalized at a wide variety of agencies, formally altering those agencies' perceptions about their roles and how to manage them. Whether these perceptions would outlast ETIP and continue to spawn new modifications as needed was to be hoped for.

3. How much did ETIP learn about change in government and industry?

ETIP derived from its experiments a breadth and depth of new knowledge about the complexities woven into the fabric of government-industry interaction. This knowledge filled to a considerable extent the vacuum perceived in the early 1970s and provided a basis upon which future government decision-making can and should be made.

Above all, ETIP learned through the trial and error processes of its collaborative strategy of administrative experimentation that its strategy was a successful way to achieve change in government line-agency policies and procedures.

An ETIP-like process is vital to government if that government hopes to keep abreast of an ever more rapidly changing world. Policy that affects innovation in the private sector is being made continuously by government and requires monitoring and modification, but agencies of government have not yet learned this basic lesson that ETIP learned, the lesson that undergirded all of the program's activities.

At ETIP's end a large task -- part learning and part application -- remained to be accomplished. It is likely that it can only be done under the aegis of an organization like ETIP, a third-party agency capable of sparking formation of collaborative problem-solving partnerships.

In 1982 there was no reason to expect that government would soon institute another such effort or agency, or that line agencies would learn the necessary lessons, develop the necessary perspectives and approaches, or form the necessary collaborative partnerships unless such an agency were created as a continuing resource to facilitate those developments.

ETIP ended just when its efforts were beginning to pay off. Once dismantled, it is likely to take many years of renewed effort before ETIP's kind of expertise will again be internally available to government.

Such an agency requires a home where protection of funds, time-perspective, autonomy, and freedom from political and bureaucratic interference can be provided. NBS provided such an environment for several years.

Should government again discover the need to experiment with change and decide to reestablish an ETIP-like agency, various alternative potential homes for its activities should be explored, including establishment of an independent existence as a quasi-government entity. Such questions, however, address themselves to future policy-makers once a commitment to experimentation with government policies and processes is reawakened by the rediscovery of need. Necessity remains the mother of invention.

APPENDIX

How to Locate ETIP Records

In the following pages of this appendix, the individual projects of the Experimental Technology Incentives Program (ETIP) are listed. The projects are listed in numerical sequence. All projects when they were initiated were assigned a number. Some of these projects were never implemented, and this fact is noted where appropriate. After this list is found a compilation of the reports associated with these numbered projects. Readers of this final report may wish further detail on the projects described in the preceding pages by ordering any of these reports. If further detail is needed (or if the person has difficulty in ordering any of the reports listed), the National Bureau of Standards (NBS) should be contacted. General inquiries can be handled by the Inquiry Service of the Technical Information and Publications Division (Area Code 301/921-2318) or the Public Information Division (921-3112). For technical detail and data, interested persons should contact Mr. Richard Penn of the National Engineering Laboratory at the Bureau (921-3324). Mr. Penn is the former Acting Director of the Program and is intimately familiar with most of the individual projects.

Technical data for each of the projects are found at increasing levels of detail in the records system established at the termination of ETIP. These levels are:

1. The final ETIP report and other project reports.
2. Project overviews for each of the projects.
3. Individual project files.

Interested persons would be advised to begin with published reports. If further detail is needed, the next step is the project overview. Mr. Penn has a copy of each of these overviews. In addition, each individual project file contains a copy of the overview for that project. Each overview includes a brief description of the project, its objectives, the approach taken, financial history, lessons learned, and resulting reports. If even greater detail is desired, interested persons can access the individual project files by contacting any of the offices listed above. Until the spring of 1983, these files will be located physically at NBS. After this, they will be removed to the Federal Records Center in Suitland, Maryland. Despite this move, all inquiries should continue to be made to NBS, which alone has the authority to acquire the individual project files.

In most cases, the reports listed below are obtainable through the National Technical Information Service (NTIS). In some projects, a decision was made not to publish certain reports. In any case, all reports are filed in the individual project files.

List of ETIP Projects by Number

Projects have been divided into the categories of Regulation, Procurement, Research and Development (R&D), Small Business, Economic, Assistance, Experimental Methods, Office of Strategy and Evaluation (OSE), and Other. Projects were placed into these categories either by (1) the ETIP area which generated them or (2) in cases where no area was identified, by the content of the project. "Other" has been used for projects where content did not fit any category or was unknown. The OSE category refers to projects generated by the OSE group which was added to ETIP to support Department of Commerce initiatives in technological innovation. OSE projects have not been subdivided into narrower categories. An asterick (*) means that the project was never implemented.

Number	Title	ETIP Area
1	Power Lawn Mower Procurement Experiment	Procurement
2	Room Air Conditioner Procurement Experiment	Procurement
3	Frostless Refrigerator Procurement Experiment	Procurement
4	Home Water Heater Procurement Experiment	Procurement
5	Kitchen Range Procurement Experiment	Procurement
6	Agency Initiated Design of Procurement Experiments*	Procurement
7	Research Effort in Fiber, Textile, and Apparel Flammability	R&D
8	Analysis of the Dynamics Underlying Regulatory Changes Having a Significant Effect on Innovation	Regulation
9	Imperfections in Capital Markets	Economic Assistance
10	Analysis of Reasons for Nonacquisition of Independent Inventions by Corporations and Patent Broker/Developers*	R&D
11	Analysis of Federal Demonstration Projects	R&D
12	Commercial Potential of Federal Invention Disclosures Rejected for Patent Filing*	R&D
13	Application of University Research Output	R&D
14	Guidelines for Industrial R&D Aggregation*	R&D
15	Enhancing the General Welfare of U.S. Industry*	R&D
16	Development of Models for Selecting Technology-Stimulating Policy Tools*	Other
17	Federal Contingency Planning for Anticipated Technological Crisis	Economic Assistance
18	Foreign Research Development Corporations*	R&D
19	Federal Funding of Civilian R&D	R&D
20	Creation of National Product Marketing Service*	Other
21	A Survey of Management's Opinion About the Relationship Between Regulation and Innovation*	Regulation
22	Use of Regulatory Authority to Stimulate Nonmandated Technological Change*	Regulation
23	An Examination of Methods Which May Be Used to Stimulate the Adoption of Regulations Which Provide an Incentive for Innovation*	Regulation
24	Assistance in the Design of a Federal Institution for Stimulating Private Sector R&D*	R&D
25	Analysis of Barriers to Technological Change for ETIP Procurement Experiments*	Procurement
26	Development of Models for Achieving Mandated Technological Change*	Regulation

Number	Title	ETIP Area
27	Development of Procedures for Evaluating Technology-Based Firms for SBA Funding*	Small Business
28	Assisting Small Firms Required by Regulation to Undergo Technological Change	Small Business
29	Conference on Federal/Industrial Partnership in New Product Development	Procurement
30	Intergovernmental Conference on Public Civilian Technology Policy*	R&D
31	Deregulation of Rail Produce Shipments	Regulation
32	Connecticut Product Development Corporation	R&D
33	The Relationship Between R&D Funding and Environmental Regulation*	Regulation
34	Providing Incentives for Large Users of Electrical Energy to Use It More Efficiently*	Other
35	Life-Cycle Costing Applied to the Procurement Process*	Procurement
36	LCC Guide for Evaluating Building Design Alternatives	Procurement
37	Increasing Health Care Productivity Through an Improved Selection of Technologies*	Procurement
38	Design of Federal Procurement Experiments for Health Care Delivery	Procurement
39	Development of Guidelines for the Use of Performance vs. Design Specifications in Procurement*	Procurement
40	Design of Three Procurement Experiments	Procurement
41	Design of Additional Federal Procurement Experiments	Procurement
42	Systematizing the Use of Federal Procurement Incentives in Federal Purchasing	Procurement
43	Government Market Research for Procurement Guidance*	Procurement
44	Experiment Design for Industry-Specific Regulation	Regulation
45	Experiment Design for Process-Oriented Regulation	Regulation
46	Competency Evaluation of Small R&D Firms	Small Business
47	Accelerating the Licensing of Nuclear Power Reactors	Regulation
48	An Experiment in the Regulation of Pesticides	Regulation
49	Regulating the Irradiation of Foods*	Regulation
50	Regulation of Renewable Resources*	Regulation
51	Design of Regulations for Public Utility Commissions*	Regulation
52	Regulating New Pharmaceuticals*	Regulation
53	Government/Industry Joint Venture in R&D*	R&D
54	Accelerating the Use of Solar Energy Research*	Other
55	Technology Impact Statements*	Regulation
56	Geothermal Energy Technology Delivery System*	Other
57	Intersectoral Transfer of a Building Technology by a Major User*	Procurement
58	Automobile Tires*	Procurement
59	Acquisition of High Speed Printer Ribbon on a Life-Cycle Basis	Procurement
60	Public Market Aggregation as an Incentive for Technological Change	Procurement
61	Biomedical Monitoring Systems (BMS) Procurement Experiment*	Procurement
62	Blood Tubes Procurement Experiment*	Procurement
63	Internally Oriented Life-Cycle costing (LCC) Program for Federal Purchasing	Procurement

Number	Title	ETIP Area
64	Value Incentive Contracting Program for Federal Purchasing	Procurement
65	Utilizing University Research in Transportation*	R&D
66	Technical Evaluation*	Other
67	New Modular Integrated Utilities System (MIUS) Application Project	R&D
68	Institutional Evaluation Through Hindsight-Tracer Studies on Educational R&D Products and Programs*	R&D
69	An Examination of the Cooperative Agreement as an Element in Technology Delivery Systems*	R&D
70	Payment of Costs Incurred by the Federal Supply Service in Providing Background Information and Conducting Preliminary Studies on Potential ETIP Projects	Procurement
71	Acquisition of General Purpose Hard Surface Cleaning Agents on a Performance Basis	Procurement
72	Technical Assistance to the Procurement Policy Area of ETIP	Procurement
73	Oscilloscopes*	Procurement
74	Procurement of Upholstered Furniture Using Performance Specifications	Procurement
75	Systematizing Local Procurement as the Preface to Technological Change	Procurement
76	Experiments in Computer Applications to Electric Rate Making-Lag Reduction	Regulation
77	Symposium in Assistance to Small Technology-Based Firms	Small Business
78	Data Collection, Summarization, and Interpretation for ETIP Project with Connecticut Product Development Corporation	R&D
79	Survey of Five-Year Results of Innovation Loan Program	Small Business
80	Systematizing the Design, Development and Use of Incentives in the Procurement of Medical Equipment and Supplies	Procurement
81	Design of Federal Procurement Experiments for Improved Health Care Delivery	Procurement
82	Office Copiers*	Procurement
83	Information Management in Procurement*	Procurement
84	Regulation, Competition and Innovation*	Other
85	Using Technology to Improve the Data and Timeliness of the Regulatory Process for Occupational Health and Safety	Regulation
86	Experiment in Contractor Selection*	Other
87	Management of Federal Civilian Research and Development Programs	R&D
88	Experiment in Drug Lag Reduction	Regulation
89	The Connecticut Experiment*	R&D
90	Evaluation of Federal Supply Service Procurement Experiments*	Procurement
91	Evaluation of ETIP Procurement Experiments at the State and Local Levels under ETIP Projects No. 60 and No. 75*	Procurement
92	(Not Used)*	
93	Federal Financial Assistance and Technological Change	Economic Assistance
94	Evaluation of ETIP	Other
95	Evaluation of Project "Accelerating the Establishment of Standards by the Nuclear Regulatory Commission (ETIP #47)	Experimental Methods
96	Real-Time Case History of ETIP Project 67: Integrated Utility System	R&D

Number	Title	ETIP Area
97	Evaluation of the Inter-Organizational Consortium for Research and Development on Flammable Fabrics	R&D
98	Improving the Standard Setting Process*	Regulation
99	Expanded Nuclear Standards Project*	Regulation
100	Regulation of Competition*	Regulation
101	Anti-Trust Boundary Project*	Regulation
102	Regulatory Degree Project*	Regulation
103	Evaluate Standards Project*	Regulation
104	Evaluating Economic Regulation*	Regulation
105	Evaluating Certification Projects*	Regulation
106	Confirming Procurements (FSS)*	Procurement
107	Design of Procurement Experiments*	Procurement
108	Monitoring Assistance*	Other
109	Federal Procurement of Health Related Goods (Eval)*	Other
110	Space Procurement (Eval)*	Other
111	Market Planning Project*	Other
112	R&D Projects (Eval)*	Other
113	Test Loan Evaluation Procedure*	Other
114	Test Small Business Regulatory Compliance Procedures*	Other
115	Exploratory Analysis*	Other
116	Case Studies in Procurement	Procurement
117	The Implementation of Life-Cycle Costing at Federal Supply Service--An Evaluation Plan for the Agency Effects of the Implementation*	Experimental Methods
118	Preparation of a Case Study on the Procurement of Window Air Conditioners	Procurement
119	Evaluate LCC Seminars	Experimental Methods
120	Commercial and Technological Impacts of the Procurement Experiments	Experimental Methods
121	The Agency and Limited Commercial Effects of the ETIP Procurement Experiments	Experimental Methods
122	The Agency Effects of Policy Changes Implemented on the Basis of ETIP Procurement Experiments*	Other
123	Case Studies in Procurement-Value Incentive Clause	Procurement
124	Technical Assistance to Procurement Program Area of ETIP	Procurement
125	Symposium for the Dissemination of Results from the Team Project for the Development of Flame Resistant Polyester/Cotton Fabrics	R&D
126	An Expanded Program for the Dissemination of Results from a Team Project for the Development of Flame Resistant Polyester/Cotton Fabrics	R&D
127	Workshops on Technology and the Law	Regulation
128	Campus-Community Integrated Utility System*	R&D
129	Procurement of Paint*	Procurement
130	Survey on the Role of State Legislators in Procurement Policy	Procurement
131	Warranty*	Procurement
132	Refinement and Dissemination of Policy Issues for Anticipated Crises in Commodity Supplies	Economic Assistance
133	National Conference of State Legislatures*	Procurement
134	Evaluation of Consortium Results	R&D

Number	Title	ETIP Area
135	Expansion of the Energy Report	Economic Assistance
136	Small Business (Design of Analysis)	Economic Assistance
137	Directed Communication Services for the Procurement Program Area of ETIP	Procurement
138	Forest Service Tool Sheath	Procurement
139	Use of Procurement Incentives in the Purchase of Headlamps	Procurement
140	Development of Experiment in Communications Regulation	Regulation
141	Development of Surgical Glove Specification and Preparation of Case Study	Procurement
142	Technical Assistance in Procurement Experiments	Procurement
143	Hypotheses Concerning the Influence of Department of Defense Sponsorship of Electronics Research and Development on the Development of the Civilian Electronics Industry	R&D
144	Dissemination of Analysis of Federal Demonstration Projects Study	R&D
145	Solar Economic Incentives: Policy Research Through Retrospective and Experimental Analysis	Economic Assistance
146	Commercial Commodity Acquisition Program	Procurement
147	Warranties (FSS)	Procurement
148	SEC--A Monitoring System for Effective Regulation of Venture Capital Markets	Economic Assistance
149	Evaluation Potential for Regulatory Lag Reduction Experiments	Regulation
150	Prototype Purchase - Lawn Mowers	Procurement
151	Developing Experiments in Occupational Health and Safety Regulation	Regulation
152	Continued Development of Systems for the Evaluation of the Agency and Commercial Impacts of ETIP Experiments*	Experimental Methods
153	Experiments in Noise Regulation	Regulation
154	Evaluation of Communications Regulation Experiments Feasibility	Regulation
155	R&D Expenditures, Productivity, and Economic Growth	R&D
156	Provide Technical Assistance for the PHS Experiment	Procurement
157	Data Collection and Analysis Support for ETIP Regulatory Experiments	Experimental Methods and Regulation
158	Pesticide Regulation Experiment	Regulation
159	Development of an ETIP Communications Program (Washington Marketing Group)	Procurement
160	Improving Rule Making at Federal Trade Commission	Regulation
161	Communications Deregulation Experiment	Regulation
162	Assistance to ETIP in Establishing Effective Interaction with Key Officials of Office of Federal Procurement Policy (OFPP)	Procurement
163	Implementation of Project 76 RAm Model in Boston Edison Rate Case	Regulation
164	R&D Technological Change and Economic Growth	R&D
165	Energy Intensive Products - LCC	Procurement
166	Federal Policies to Develop the Interface Between Public Utilities and Dispersed, Small-Scale Solar Energy Systems--DOE	Economic Assistance

Number	Title	ETIP Area
167	Federal Policies and Private Investment in Technological Change	Economic Assistance
168	Taxonomy of Incentives	Regulation
169	Analytical Support and Data Collection in Regulatory Administrative Experiments	Experimental Methods and Regulation
170	Analytical Support and Data Collection in Procurement Administrative Experiments	Experimental Methods
171	Preparation of Issues Paper on Product Remanufacturing	OSE
172	Investigate the Cumulative Impact of the Government Regulations on the Innovation in the U.S. Steel Industry from 1945 to the Present Time	OSE
173	Summary and Synthesis of Regulatory Experimentation Case Studies	Regulation
174	Development of Issues Papers for a Policy Review of Industrial Innovation	OSE
175	Preparation of Reports for the Public Interest Group Advisory Committee	OSE
176	Technological Innovation and the U.S. Economy	OSE
177	The Role of the State and Local Government in Technological Innovation: A Conceptual Paper	OSE
178	Industrial Innovation - The State and Local Government Role	OSE
179	Labor's Role in Industrial Innovation	OSE
180	Technology and the U.S. Economy: International Dimensions	OSE
181	Conduct of Industry Survey on Multiple Award Contracts	Procurement
182	Air Cargo Deregulation Experiment	Regulation
183	Operation Breakthrough, OMB Circular A-109 and Acquisition Differences	Procurement
184	Conference of Small R&D and Technically Based Companies on Opportunities for Small R&D Companies in the Federal Government	OSE
185	Project Plan for Quiet Products	Procurement
186	Research on the Pattern of U.S. Growth Relative to Its Major Competitors	OSE
187	Colloquium: Industrial Innovation and Public Policy Options	OSE
188	Evaluation Process for Environmental Regulation Development	Regulation
189	Market Place Incentives for Air Pollution Reduction	Regulation
190	Potential Problems and Barriers to the Development of a VLSI-Based Technology for the Semiconductor Industry	OSE
191	(A) GSA Implementation of Domestic Policy Review Recommendations*	Procurement
	(B) Alternative Approaches to National Technological Goals	OSE
192	Study: Adversarial and Cooperative Relationships Between Business and Government in Four Countries	OSE
193	Analysis of State-Operated Sources of Venture Capital	OSE
194	Assessment of Factors Affecting the U.S. Semiconductor Industry and Identification of Possible Government Intervention to Ensure the Viability of the Industry*	OSE
195	Patents and the Technological Innovation Process*	OSE
196	Railroad Management Innovations for New Regulatory Era	Regulation
197	Research Support of the Center for the Utilization of Federal Technology	OSE

Number	Title	ETIP Area
198	Study the Economics of the Semiconductor Industry	OSE
199	Strategic Analysis of the U.S. Semiconductor Industry*	OSE
200	Background Study and Criteria to Develop and Establish Fellowship Program in CUFT, DOC	OSE
201	Study: Patent System for the 1990's	OSE
202	Study: Decade of Patent Innovation	OSE
203	Study: Industrial Property Mechanisms	OSE
204	Study: Restructuring of the Present System of Patents and Copyrights	OSE
205	Enhancing the Competitiveness of the U.S. Semiconductor Industry*	OSE
206	Evaluation of Deregulation Trends in the Rail Industry	Regulation

A List of Published ETIP Reports

The following is a list of ETIP reports which have been published by the National Bureau of Standards (NBS), the National Technical Information Service (NTIS), or the Government Printing Office (GPO). NBS numbers are NBS-GCR-ETIP or as indicated. NTIS numbers are PB or COM, or other sources as indicated.

Project Number	Title	Author	Date	NBS No.	NTIS No.
1	Experimental Technology Incentives Program Procurement Experiment Plan 1: Stimulating Noise Control Technology in Consumer Products Through Federal Government Procurement Action	Booz-Allen Applied Research	October 1973	73-04	COM-74-10256/7GI
2	Experimental Technology Incentives Program Procurement Experiment Plan 2: Stimulating Efficiency and Noise Abatement in Room Air Conditioners Through Federal Government Procurement Action	Booz-Allen Applied Research	November 1973	73-05	COM-74-10257/5GI
3	Experimental Technology Incentives Program Procurement Experiment Plan 3: Stimulating Increase Efficiency in Frostless Household Refrigerators Through Federal Government Procurement Action	Booz-Allen Applied Research	November 1973	73-06	COM-74-10258/3GI
	A Survey of Manufacturers' Views on the ETIP Procurement Experiment, Volume One: Refrigerator-Freezers	P. C. Goodman NBS	December 1975	NBSIR 75-954	PB253242
4	A Survey of Manufacturers' Views on ETIP Procurement Experiment, Volume 2: Water Heaters	P. C. Goodman NBS	January 1976	NBSIR 76-983	PB251213
	ETIP Procurement Experiment Plan 4: Stimulating Increased Efficiency in Residential Water Heaters Through Federal Procurement Action	Booz-Allen and Hamilton, Inc.	November 1973	76-20	
5	A Survey of Manufacturers' Views on the ETIP Procurement Experiment, Volume 3: Ranges	P. C. Goodman NBS	February 1976	NBSIR 76-1027	PB253243
	ETIP Procurement Experiment Plan 5: Stimulating Technological Improvements in Household Ranges Through Federal Government Procurement Action	Booz-Allen and Hamilton, Inc.	November 1973	76-21	

Project Number	Title	Author	Date	NBS No.	NTIS No.
7	Report of Activities Carried Out Under Contract 4-35963 "Fiber, Textile and Apparel Research - Cotton Polyester Blends", July 1974-75	R. H. Barker J. E. Sirrine Clemson University	August 1975	75-01	COM-75-11369
	Development of Flame Retardants for Polyester/ Cotton Blends	R. H. Barker M. J. Drews Clemson University	September 1976	76-22	PB257884
9	An Analysis of Venture Capital Market Imperfections - Executive Summary	Charles River Associates, Inc.	February 1976	76-08	PB254078
	An Analysis of Venture Capital Market Imperfections - Final Report			76-12	PB254996
11	Analysis of Federally Funded Demonstration Projects - Executive Summary	W. S. Baer L. L. Johnson E. W. Merrow Rand Corporation	April 1976	76-05	PB253108
	Analysis of Federally Funded Demonstration Projects - Final Report			76-06	PB253918
	Analysis of Federally Funded Demonstration Projects - Volume 3, Supporting Case Studies			76-07	PB262123
17*	A Framework for Analyzing Commodity Supply Restrictions	Charles River Associates, Inc.	August 1976	76-24	PB258093
	Cartelization in the World Cobalt Market: Economic Analysis and Policy Implications		August 1976	76-25	PB264386
	Policy Implications of Producer Country Supply Restrictions: The World Platinum and Palladium Markets		August 1976	76-28	PB264387
	Policy Implications of Producer Country Supply Restrictions: The World Manganese Market		September 1976	76-29	PB264388

Project Number	Title	Author	Date	NBS No.	NTIS No.
17*	Policy Implications of Producer Country Supply Restrictions: The World Copper Market		August 1976	76-30	PB264389
	Policy Implications of Producer Country Supply Restrictions: The World Chromite Market		September 1976	76-31	PB264390
	Policy Implications of Producer Country Supply Restrictions: The World Aluminum/Bauxite Market	Charles River Associates, Inc.	September 1976	76-32	PB264391
	Policy Implications of Producer Country Supply Restrictions: The World Energy Market		November 1976	76-33	PB264392
	Policy Implications of Producer Country Supply Restrictions: Overview and Summary		February 1977	77-36	PB264393
	* Available as a set under NTIS No. PB264385				
19	Federal Funding of Civilian Research and Development, Volume I, Summary	Arthur D. Little	February 1976	76-03	PB251266
	Federal Funding of Civilian Research and Development, Volume II, Case Study			76-04	PB251683
28	Impact on Small Business of Government Regulations Which Force Technological Change	Charles River Associates, Inc.	September 1975		GPO SN 045-000-00144-0
31	A Long Term Study of Produce Transportation	Manalytics, Inc.	December 1977		Federal Rail Administration
	Volume 1, Executive Summary				FRA OOPD 78-2.1
	Volume 2, General Summary				FRA OOPD 78-2.2
	Volume 3, A Profile of Fresh Fruit and Vegetable Shipments from Selected Growing Areas				FRA OOPD 78-2.3
	Volume 4, A Profile of Fresh Fruit and Vegatable Marketing and Distribution in Selected Destination Cities				FRA OOPD 78-2.4
	Volume 5, Fresh Fruit and Vegetables - Transportation Services and Costs				FRA OOPD 78-2.5
	Volume 6, Transportation Equipment Technology				FRA OOPD 78-2.6
	Volume 7, Fresh Fruit and Vegetable Packinghouse Operations and Economics				FRA OOPD 78-2.7

Project Number	Title	Author	Date	NBS No.	NTIS No.
31	Volume 8, Evaluation of Logistics Alternatives Volume 9, Fresh Fruit and Vegetable Commodity/ Origin/Destination Selections Description				FRA 00PD 78-2.8 FRA 00PD 78-2.9
	A Long Term Study of Produce Transportation	Manalytics, Inc.	December 1977		Federal Rail Administration
	Volume 10, Produce Shipment Description Model Volume 11, Glossary of Produce Marketing and Distribution				FRA 00PD 78-2.10 FRA 00PD 78-2.11
	Interim Report on Potential ICC/ETIP Administrative Experiments (under Project 169)	M. Mulkey W. Frederick Performance Development Institute D. Fulmer, NBS	March 1980	80-85	PB80202375
	Exempt Rail Transportation of Fresh Fruits and Vegetables, Initial Impacts	Manalytics, Inc.	March 1980		ICC, Office of Policy and Anaysis, Contract No. 80-M-1159
45	Economic Aspects of Joint R&D Ventures and the Private Sector (see Project No. 173 for Summary of other work done in Project No. 45)	S. Buchanan Public Interest Economics Center	October 1978	79-69	PB80208861
47	An Experiment on Accelerating the Writing of Nuclear Standards Conducted for the American Standards Institute	N. C. Wittenbrock Battelle	September 1975	76-16	PB256129
	An Assessment of an Experiment Accelerating the Development of Nuclear Standards (done under Project No. 157)	J. P. Woodward Performance Development Institute S. Garrity, NBS	June 1980	NBSIR 80-2086	PB80202104
48	Incentives for R&D in Pest Control (Vols. I & II)	Arthur D. Little	December 1976		EPA C540/9-77-008

Project Number	Title	Author	Date	NBS No.	NTIS No.
48	Developing Incentives for Pest Control Methods, Proceedings of a Conference, October 26-27, 1976 (also see Project No. 158)	Arthur D. Little	January 1977	76-34	PB263275
63	Life Cycle Costing Procurement, Case 1, Room Air Conditioners	Logistics Management Institute	July 1975	76-13	PB253475
	Life Cycle Costing Procurement, Case 2, Water Heaters	Logistics Management Institute	July 1975	76-14	PB253476
	Life Cycle Costing Procurement, Case 3, Gas Ranges		January 1976	76-15	PB253477
	Life Cycle Costing - Case Study (A Compilation of Previously Issued Studies)		May 1977	77-37	PB268162
67	A Guide to the Dollar Savings Potential in Integrated Energy/Utility Systems	Reynolds, Smith and Hills	December 1976		PB266042/1WE
	Feasibility Study and Conceptual Design at the University of Florida		October 1976		PB266043/4WE
	Feasibility Study and Conceptual Design at		December 1976		PB266044/7WE
	A Guide to the Available Technology for Integrated Energy/Utility Systems		February 1977		PB269042/1WE
	A Guide to Community Planning for Integrated Energy Utility Systems	P. L. Geiringer and Associates	October 1978		PB290675/AS
70	Proceedings of Procurement Practices Symposium, Federal, State, and Local, January 28-30, 1975	T. J. Fody J. G. Berke, NBS	May 1975	NBSIR 75-716	COM7511210
76	Overview Report: Experiment in Computer Applications for Regulatory Agencies	Temper, Barker & Sloane, Inc.	September 1979	79-70	PB300770
	Regulatory Lag: Administrative Causes and Solutions		September 1979	79-72	PB80146776

Project Number	Title	Author	Date	NBS No.	NTIS No.
76	Regulatory Analysis Financial Model RAM Descriptive Documentation, Vol. 1		November 1979	79-73	PB80150675
	Performance Evaluation Model: Suggestions for Use and Description of the Model		November 1979	79-74	None
	Use of A Future Test Year for Electric Utility Ratemaking	J. W. Wilson & Associates, Inc.	November 1979	79-75	PB80203177
	Use of A Future Test Year for Electric Utility Ratemaking, Appendices A-D			79-76	None
	Automatic and Discretionary Adjustment Procedures for Electric Utility Rates, Volume I			79-77	None
	Automatic and Discretionary Adjustment Procedures for Electric Utility Rates, Volume II			79-78	PB80208978
	Innovative Approaches to Electric Utility Rate Structure: Marginal Costs and Time-Varying Rates, Volume I and Usage and Evaluation			79-79	PB80148604
	Innovative Approaches to Electric Utility Rate Structure: Marginal Costs and Time-Varying Rates, Volume II			79-80	None
	The Measurement of Electric Utility Productivity, Volume I, Usage of the Work on Electric Utility Productivity: An Evaluation		January 1980	79-81	PB80147333
	The Measurement of Electric Utility Productivity, Volume II		January 1980	79-82	PB80151220
77	Report of Workshops on Four Specific Problems of Importance in Government Relations with Small Technically Based Companies and Inventor-Entrepreneurs - Final Report	American Assoc. of Small Research Companies	October 1975	75-02	
79	An Evaluation of the Small Business Administration Innovation Loan Program - Final Report	Moshman Assoc., Inc.	April 1976	76-11	PB253115

Project Number	Title	Author	Date	NBS No.	NTIS No.
80	Directory of Living Aids for the Disabled Person	Veterans Administration	April 1982		GPO 982-361-487-3387
85	Prospects for an OSHA/ETIP Project to Facilitate Technological Innovation (see Project No. 157)	M. Mulkey, Urban Institute R. G. Weiss, NBS	May 1980	NBS Tech. Note 1114	PB80179260
87	Management of Federal R&D for Commercialization, Executive Summary	N. M. McEachron et al., SRI International	September 1978	78-57	PB292851
	Management of Federal R&D for Commercialization, Final Report			78-58	PB292852
	Management of Federal R&D for Commercialization, Appendices: Supporting Documentation			78-58A	PB292853
	78-57, 78-58, and 78-58A				Available as a set under PB292850
78	Subsidies, Capital Formation, and Technology Change; Municipal Wastewater Facilities, Vol. 1	Charles River Associates	July 1977	78-40	PB285288
	Subsidies, Capital Formation, and Technological Change; Mass Transit, Vol. 2		November 1977	78-41	PB285289
	Subsidies, Capital Formation, and Technological Change; First Generation Nuclear Power Plants, Vol. 3		November 1977	78-42	PB285290
	Subsidies, Capital Formation, and Technological Change; Maritime Transport, Vol. 4		December 1977	78-43	PB285291
	Subsidies, Capital Formation, and Technological Change; Primary Scientific and Technical Journal Publishing, Vol. 5		September 1978	78-44	PB285292
	Subsidies, Capital Formation, and Technological Change; Health Facilities, Vol. 6		September 1978	78-45	PB285293

Project Number	Title	Author	Date	NBS No.	NTIS No.
78	Subsidies, Capital Formation, and Technological Change; Local Air Transport, Vol. 7		January 1978	78-46	PB285294
	Subsidies, Capital Formation, and Technological Change; Summary and Conclusions, Vol. 8		May 1978	78-47	PB285295
	78-40 through 78-47				Available as a set under PB285287
88	The Evaluability Assessment of the Developing Experiment in Post Marketing Surveillance of Prescription Drugs (also see Project 169) ++	S. Clarren, Performance Development Institute	March 1981	81-96	PB81223232
94	Bureaucracy and Innovation: An Ethnography of Policy Change	G. M. Britan	January 1981		Sage Library of Social Research Volume 115 ISBN 0-8039-1506-3
96	A Real-Time Case History of ETIP Project 67-- Integrated Utility System Application	J. G. Taylor L. C. Lamar System Planning Corporation	March 1978	78-59	PB292770
116	Life Cycle Costing in the Procurement of Electric Ranges	Logistics Management Institute	March 1976	76-09	PB253488
	Life Cycle Costing in the Procurement of Refrigerator-Freezers		March 1976	76-10	PB253260
118	Life Cycle Costing in the Procurement of Window Air Conditioners	Logistics Management Institute	July 1976	76-19	PB256642
120	Assessing the Results of the Portable Oxygen Generator Experiment	N. B. McEachron E. G. Woodward SRI International	October 1977	78-50	PB289886
	Assessing the Results of the LCC Water Heater Experiment, Volume 1	SRI International	September 1977	78-51	PB291826
	Assessing the Results of the LCC Water Heater Experiment, Volume 2	SRI International	September 1977	78-52	PB291827

++ As this report was going to press, ETIP published under Project 169: An Experiment in Post Marketing Surveillance of Prescription Drugs: An Initial Status Report, November 1982, NBS-GCR-ETIP 82-99

Project Number	Title	Author	Date	NBS No.	NTIS No.
120	Agency Impact Analysis: Life Cycle Costing in the Public Building Service	J. Lawrence Research Triangle Institute S. Garrity, NBS	1979	79-68	PB81204356
121	Prototype Procurement--A Case Study in Experimental Technology Check Wrapping Machines of the U.S. Treasury Department	Timbers & Co.	November 1977	77-39	PB273950
123	Value Incentive Program, Household Goods Shipping Containers	Kempter-Rossman International	July 1976	76-19	PB256643
123	Value Incentive Program: Computer Room Air Conditioner	Kempter-Rossman International	July 1976	76-23	PB258991
	Value Incentive Program, Energy Conservation Compressors for Computer Room Air Conditioning		November 1976	76-26	PB259978
	Value Incentive Program, Reduce Welding/Brazing on Wardrobe Hinge		October 1976	76-27	PB260523
132	Commodity Supply Policies	Charles River Associates	October 1977	77-38	PB272700
143	The Influence of Defense Procurement on the Development of the Civilian Electronics Industry	J. M. Utterback A. E. Murray Massachusetts Institute of Technology	1978	78-49	PB290164
148	Evaluating the Impact of Securities Regulation on Venture Capital Markets	J. R. Booth J. J. Cordes George Washington University G. Tassey, NBS	June 1980	NBS Mono-graph 166	PB81103582
	The Effectiveness of Venture Capital Markets in the U.S. Economy	G. Tassey, NBS	1977		Public Policy Vol. 25, No.4 Fall 1977
157	The FCC Public Message Services Policy Change: An ETIP Evaluability Assessment Report, Volumes 1 and 2 (also see Project No. 16)	J. Bell S. Kirby S. Watson Urban Institute R. G. Weiss, NBS	September 1979	NBS Tech-nical Note 1104	GPO SN-003-003-02117-2

Project Number	Title	Author	Date	NBS No.	NTIS No.
157	Prospects for an OSHA/ETIP Project to Facilitate Technological Innovation (also see Project No. 85)	M. A. Mulkey Urban Institute R. G. Weiss, NBS	May 1980	NBS Technical Note 1104	PB80179260
	Balancing the Objectives of Clean Air and Economic Growth: Regulated Markets in Emission Reductions	Urban Institute	January 1979	79-62	PB300835
	Environmental Regulation in Theory and Practice: EPA's Process of Setting Best Pract. Control Tech. Standards		December 1978	79-63	PB297499
	Regulatory Administrative Experiment Manual	Urban Institute	February 1979	79-64	PB298446
	The Regulatory Processes & Effects Project		February 1979	79-65	PB298631
	An Assessment of an Experiment Accelerating the Development of Nuclear Standards (also see Project NO. 47)	J. P. Woodward Performance Development Institute S. Garrity, NBS	June 1980	NBSIR 80-2086	PB80202104
158	An Evaluation Design Concept for Regulatory Reform: The Waiver of Efficacy Data (also see Project No. 48)	Arthur D. Little	May 1979	79-71	PB300846
161	The FCC Public Message Services Policy Change: An ETIP Evaluability Assessment, Volumes I and II	J. Bell, et al. Urban Institute R. G. Weiss, NBS	September 1974	NBS Technical Note 1104	GPO SN-003-003-02117-2
	Toward Competitive Provision of Public Message Services? (also see Projects 157 and 169)	Performance Development Institute	October 1981	81-97	

Project Number	Title	Author	Date	NBS No.	NTIS No.
164	An International Study of Economic Benefits Attributable to R&D, by Source and Sector of Performance	R. U. Ayres J. Lewis S. D. Collier Delta Research Corporation	June 1978	78-60	PB292783
166	The Solar Energy/Utility Interface, Proceedings of Workshops and Conference	R. J. Harman, Editor George Washington University	December 1978		Department of Energy HCP/4202-1
167	Innovation, Competition, and Government Policy in the Semiconductor Industry Industry	Charles River Associates	March 1980	80-91	PB81105009
	Innovation, Competition, and Government Policy: A Framework for Analysis		April 1980	80-92	PB80226327
168	Taxonomy of Incentive Approaches for Stimulating Innovation	J. Booth Z. Cook A. R. Ferguson Public Interest Economics Center	August 1978	78-53	PB287932
169	Interim Report on Potential ICO/ETIP Administrative Experiments (also see Project No. 131)	M. Mulkey W. Frederick Performance Development Institute D. Fulmer, NBS	March 1980	80-85	PB80202575
	Incentives for Technological Innovation: An ETIP Policy Research Series				
	Volume 1, Emission Offset Policy at Work: A Summary Analysis of Eight Cases	W. H. Foskett Performance Development Institute	April 1980	80-86	
	Volume 2, Market Mechanisms for Emission Regulation & Enforcement of Emission Limits: Deterrence & Demand		May 1980	80-87	

Project Number	Title	Author	Date	NBS No.	NTIS No.
169	Volume 3, Opportunities for Innovation: Administration of Sections 111 (j) and 113 (d) (4) of the Clean Air Act & Industry's Development of Innovative Control Technology	J. Evans Performance Development Institute	April 1980	80-88	PB80205024
	Volume 4, Analysis of the Rationale & Public Comment Regarding EPA's Proposed Regulation on Regional Consistency	J. Evans W. H. Foskett Performance Development Institute	May 1980	80-89	PB80203730
	Volume 5, An Annotated Bibliography of Literature on Market Mechanisms & Economic Incentives for Environmental Regulation	S. Watson Performance Development Institute	April 1980	80-90	PB80205610
	Volume 6, Innovation by Regulation: The Administration of Control Technology Requirements Under the Clean Air Act	Performance Development Institute	March 1981	81-93	PB81221616
	Volume 7, Periodic Review and Technological Escalation of Performance Standards: New Source Performance Standards Review Process		December 1980	81-94	PB81218117
	Volume 8, Controlled Trading and Site Specific SIP Revisions: Competing for Attention in Crowded Administrative Routes		December 1980	81-95	PB81218273
	The Evaluability Assessment of the Developing Experiment in Post-Marketing Surveillance of Prescription Drugs (also see Project No. 88)		March 1981	81-96	PB812232
	Toward Competitive Provision of Public Message Services? (also see Project No. 161)		October 1981	81-97	PB82138819

Project Number	Title	Author	Date	NBS No.	NTIS No.
169	The Experiment in Post-Marketing Surveillance of Prescription Drugs: An Initial Status Report	S. Clarren T. Nalley C. Zuiches Performance Development Institute	November 1982	82-99	
172	Impacts of Government Regulations on the Iron and Steel Industry	Sterling Hobe Corporation	August 1978	79-67	PB289352
173	An Exploration of Regulatory Incentives for Innovation: 6 Case Studies	J. Booth Z. Cook	January 1979	79-66	PB299006
174	Technological Innovation and the U.S. Economy: The International Aspects	E. M. Graham	December 1978	see Project 180	see Project 180
175	Report of the Public Interest Subcommittee in Final Report, Advisory Committee on Industrial Innovation	Public Interest Subcommittee of the Domestic Policy Review, U.S. Dept. of Commerce	September 1979		GPO 003-000-00553-4
180	Technological Innovation for a Dynamic Economy	C. A. Hill J. M. Utterback, Editors	1979		Permagon Press LC#T21.T42 1979
186	Comparative Growth and Comparative Advantage	P. Murrell	October 1979	79-83	None
	The Comparative Structure of Growth in the Major Developed Capitalist Nations		October 1979	79-84	None
187	Industrial Innovation and Public Policy Options, Report of a Colloquium	National Academy of Engineering	1980		National Academy Press
192	A Study of Adversarial and Cooperative Relations Between Business and Government in Four Countries	J. L. Badaracco	1981		University Microfilms International 8113574
None	Study of Strategies for Market Aggregation - Final Report	J. D. Lewis H. S. Kleiman Battelle Columbus Laboratories	May 1973	73-01	COM 73-11373

Project Number	Title	Author	Date	NBS No.	NTIS No.
None	Study of Strategies for Market Aggregation Appendices	H. Kleiman J. D. Lewis W. Riddle Battelle Columbus Laboratories	May 1973	73-01A	COM 73-11373
None	Government Procurement as an Incentive to Commercial Technology and Innovation	W. P. Sommers W. Hockersmith R. W. Shaw R. Brudno Booz-Allen Hamilton	March 1973	73-02	COM 73-11375
None	Technical Transfer and Technological Innovation: Annotated and Selected Bibliography	Forecasting International LTD	July 1973	73-03	COM 73-11374
None	Development of Criteria and an Operating Procedure for Screening Government Owned Patents Final Report, Volume I	P. G. Dickey K. D. Brown R. W. Aaron S. A. Lambert ITT Research Institute	April 1973	73-07	COM 74-10939
	Volume II			73-07A	COM 74-10940
None	Proceedings of GSA/ETIP Symposium on Procurement Practices, May 29-31, 1974	NBS Federal Supply Service	January 1975	NBSIR 75-696	COM 75-10527
None	ETIP: The First 18 Months, A Progress Report of the Experimental Technology Incentives Program, National Bureau of Standards	J. D. Lewis, NBS	August 1975	NBSIR 75-778	PB246435
None	Proceedings of Procurement Practices Symposium-Health Care, October 14-16, 1975	J. G. Berke, NBS Editor Veterans Admin.	February 1976	NBSIR 76-997	PB254298
None	System Proposal Preparation and Evaluation Procedure	C. W. N. Thompson	February 1976	NBSIR 76-1124	PB273666
None	Proceedings of a Symposium: Communicating for Product Improvement	C. Hulick, NBS Editor Federal Supply Service	February 1977	NBSIR 77-1221	PB264919

Project Number	Title	Author	Date	NBS No.	NTIS No.
None	Innovation in State Public Utility Commissions: An Exploratory Study of Techniques in Energy Regulation	K. R. Flaherty, NBS	June 1980	NBSIR 80-2046	None
None	Procurement of Evaluation Systems: A Case Study of the Parametric Factor Evaluation Approach to Source Selection	A. S. Libman, NBS	July 1980	NBSIR 80-2092	PB80204654
None	Monitoring System Development: A Framework and Application	S. Garrity, NBS	September 1981	NBSIR 81-2327	PB82115817
None	A Manual for Designing and Implementing a Process to Monitor Complex System Developments	S. Garrity, NBS	September 1981	NBSIR 81-2328	PB82104308
None	Incentives for Technological Innovation in Air Pollution Reduction: An ETIP Policy Research Series, Volume 9, Internal Offsets	M. E. Mogee, NBS	April 1982	NBSIR 82-2475	PB82208372
None	Final Report - Government and Innovation: Experimenting with Change	R. Herbert H. Hoar	November 1982	82-100	

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4. TITLE AND SUBTITLE

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5. AUTHOR(S)

Richard Hebert and Ralph Hoar, Jr.

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

This final report of the Experimental Technology Incentives Program (ETIP) contains a brief history of the program, a description of the major projects and accomplishments, a listing of lessons learned and a sampling of outside views and opinions of the program's strengths and weaknesses. An appendix contains a list of all projects (numbered sequentially) and published reports. The appendix also describes the process by which greater project detail and data can be obtained

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

administrative experiments; technology policy; innovation; research and development; procurement; economic assistance;regulatio

13. AVAILABILITY

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